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# DEFENSE DEPARTMENT AUTHORIZATION AND OVERSIGHT

## HEARINGS

ON

## H.R. 4428

## DEPARTMENT OF DEFENSE AUTHORIZATION OF APPROPRIATIONS FOR FISCAL YEAR 1987

AND

## OVERSIGHT OF PREVIOUSLY AUTHORIZED PROGRAMS

BEFORE THE

COMMITTEE ON ARMED SERVICES
HOUSE OF REPRESENTATIVES
NINETY-NINTH CONGRESS
SECOND SESSION

## RESEARCH, DEVELOPMENT, TEST, AND EVALUATION—TITLE II

HEARINGS HELD
FEBRUARY 18, 19, 25, 26, 27, MARCH 4, 5, 6, 11, AND 12, 1986

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99TH CONGRESS
2D SESSION

# H. R. 4428

To authorize appropriations for fiscal year 1987 for the Armed Forces for procurement, for research, development, test, and evaluation, for operation and maintenance, and for working capital funds, to prescribe personnel strengths for such fiscal year for the Armed Forces, and for other purposes.

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IN THE HOUSE OF REPRESENTATIVES

MARCH 18, 1986

Mr. ASPIN (for himself and Mr. DICKINSON) (by request) introduced the following bill; which was referred to the Committee on Armed Services

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# A BILL

To authorize appropriations for fiscal year 1987 for the Armed Forces for procurement, for research, development, test, and evaluation, for operation and maintenance, and for working capital funds, to prescribe personnel strengths for such fiscal year for the Armed Forces, and for other purposes.

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That this Act may be cited as the "Department of Defense Authorization Act, 1987".

* * * * * * *

## TITLE II—RESEARCH, DEVELOPMENT, TEST AND EVALUATION

### AUTHORIZATION OF APPROPRIATIONS

SEC. 201. (a) Funds are hereby authorized to be appropriated for fiscal year 1987 for the use of the Armed Forces for research, development, test, and evaluation, in amounts as follows:

For the Army, $5,550,300,000.

For the Navy (including the Marine Corps), $10,586,800,000.

For the Air Force, $17,275,400,000.

For the Defense Agencies, $8,517,400,000, of which $141,800,000 is authorized for the activities of the Deputy Under Secretary of Defense, Test and Evaluation and of which $11,300,000 is authorized for the Director, Operational Test and Evaluation.

(b) There are authorized to be appropriated for fiscal year 1987, in addition to the amounts authorized to be appropriated in subsection (a) such amounts as may be necessary for unbudgeted amounts for salary, pay, retirement, and other employee benefits authorized by law for civilian employees of the Department of Defense whose compensation is provided by funds authorized to be appropriated in subsection (a).

### AUTHORIZATION OF APPROPRIATIONS FOR FOREIGN CURRENCY PURCHASES

SEC. 202. Funds are hereby authorized to be appropriated for fiscal year 1987 in the amount of $3,500,000 for the purchase of foreign currencies from the Treasury Department to pay expenses incurred in carrying out programs of the Department of Defense.

* * * * * * *

# REVIEW OF THE DEPARTMENT OF DEFENSE REQUEST FOR AUTHORIZATION, FISCAL YEAR 1987 RESEARCH, DEVELOPMENT, TEST, AND EVALUATION PROGRAM

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House of Representatives,
Committee on Armed Services,
Research and Development Subcommittee,
*Washington, DC, Tuesday, February 18, 1986.*

The subcommittee met, pursuant to call, at 2:05 p.m., in room 2212, Rayburn House Office Building, Hon. Melvin Price [chairman of the subcommittee] presiding.

## OPENING STATEMENT OF HON. MELVIN PRICE, A REPRESENTATIVE FROM ILLINOIS, CHAIRMAN, RESEARCH AND DEVELOPMENT SUBCOMMITTEE

Mr. Price. The committee will be in order.

Today the subcommittee begins its review of the Department of Defense request for authorization for the fiscal year 1987 Research, Development, Test, and Evaluation Program.

The request for the fiscal year 1987 RDT&E program totals $41.9 billion, of which $5.5 billion is for the Army, $10.6 billion for the Navy, $17.3 billion for the Air Force, $8.4 billion for the Defense Agencies, $148.4 million for Defense Testing Evaluation, and $11.3 million for the Office of the Director of Operational Test and Evaluation.

The principal witness for today and tomorrow morning is the Honorable Donald A. Hicks, Under Secretary of Defense for Research and Engineering. This will be Dr. Hicks' first appearance before the subcommittee.

Before each member is a copy of a letter of February 5, 1986, signed by me and Mr. Dickinson outlining the subjects that Dr. Hicks should address during his appearance. Specifically, we asked that Dr. Hicks focus on the manner in which the fiscal year 1987 budget request was prepared, the strategic and conventional modernization programs, the status of congressional initiatives, U.S. defense policy, and the correlation between this policy, and the request. We also asked that Dr. Hicks discuss the Department's plan to improve weapons systems testing.

It is no secret that this will be a most difficult year for the Department of Defense. There can be little doubt that the budget request for RDT&E will be reduced. The only issue is the size of the reduction. We have done our best to express our concerns to the administration but that is all history.

This year's review will not be easy for this subcommittee. I would wonder how the Department of Defense expects us to meet our commitments in reviewing a $42-billion budget without any congressional data sheets or descriptive summaries. We will complete our review of this budget by March 13. We have never begun our hearings without at least a draft of this material. We will meet our commitments with or without this data, and I would suggest, Dr. Hicks, that when you return to the Pentagon, you would see to it that this material is forwarded to the staff for our review as soon as possible.

Before recognizing Dr. Hicks, I would like to recognize our ranking member, my friend and colleague from Alabama, Mr. Dickinson.

## STATEMENT OF HON. WILLIAM L. DICKINSON, A REPRESENTATIVE FROM ALABAMA, RANKING MINORITY MEMBER, RESEARCH AND DEVELOPMENT SUBCOMMITTEE

Mr. Dickinson. Thank you, Mr. Chairman.

Mr. Secretary, we would like to welcome you in your maiden voyage here before our committee. I think it is going to be an interesting year, I know it will be, it is going to be an interesting course.

I don't want to start us off on a negative note, but I notice your budget request of $42 billion represents about 20 percent real growth over fiscal year 1986 when we take into account Gramm-Rudman. This compares to about a 5-percent real growth between fiscal year 1985 and 1986.

Using last year as a yardstick, we might reasonably expect the Congress would appropriate about $37 billion as compared to your $42 billion request. At this point, I would think that is optimistic. I don't say it won't happen, I just say from where we stand now and with the attitude and climate we have here in the House, I think it might be optimistic.

I hope that you can help us understand the reasons for the substantial growth that is requested and as the chairman and I pointed out in our letter of 5 February, we are very much interested in how you put the fiscal budget together for 1987.

I have a number of areas that I would like to ask you to specifically address in your testimony, perhaps you have already planned to do this. First, I am interested in; have you had any feedback or guidance or direction from the Packard commission?

I realize that they are in effect in a waiver, so they don't have to report in January but at the end of February, but perhaps they have had input into your request. Whether they did or not, I think we would be interested in knowing that.

Second, I would be interested in your thoughts on a 2-year authorization-appropriation budget cycle and the impact it would have on RDT&E Programs. The more I look at this, the more I talk to people, the more I am convinced that this is what we should do.

We have had so much put on us in time being telescoped to such short periods there is no orderly way and process that this committee can take all the testimony, hear all the evidence and go through the cycle and the Budget Committee doing its thing and Appropriations doing its thing, and for that reason we have been operating on the Appropriations Continuing Resolution for I don't know how many Congresses now.

We have a 2-year Congress, I think one set of hearings for a 2-year period, hearing all the witnesses and giving us a time to act with deliberation and spend more time studying what we are doing, I think it would be helpful to the Congress, I think it would save money, I think it would help you in your job, and I would be interested in knowing your personal attitude about that.

I think I would also in the strategic area, note that there is about $370 million set aside for the MX follow-on basing.

Now, regardless of how much we might be convinced we need it, we get a little weary fighting this same fight year after year. I think the Congress has been very clear that it does not intend to allow any more than 50 MX missile deployments, so that your thoughts in this area as well as in the small mobile ICBM, would be very helpful.

Should we go both tracks? Is there a change in thinking on the part of the administration?

I am also greatly concerned about the latest Soviet air-to-air capability, and helicopters, and lack of a specific program in the United States to counter this capability.

Mr. Secretary, we will have a relatively short time this year to complete our authorization bill. We very much look forward to working with you and your office. It is going to be necessary for us to coordinate more closely now perhaps than ever before so that we can meet our target and get our authorization bill through in time to deal within the budget and give the Appropriations Committee an opportunity to do their thing.

We look forward to working with you throughout the cycle and we appreciate your appearance here today and I thank you, Mr. Chairman; as far as I am concerned the floor is yours.

Mr. PRICE. Mr. Secretary.

## STATEMENT OF HON. DONALD A. HICKS, UNDER SECRETARY OF DEFENSE FOR RESEARCH AND ENGINEERING, DEPARTMENT OF DEFENSE

Dr. HICKS. Mr. Chairman, Mr. Dickinson, members of the committee, staff. I am very pleased to be here to discuss with you our Department of Defense RDT&E Program for fiscal year 1987.

As you mentioned, it is $42 billion and it represents the resources we believe we need to turn our technological capabilities into force modernization.

The issue to remember as we look at the budget is that the threat is undiminished. So whatever happens with our problems here, the problems we have to face externally are not changing, in fact they are growing.

We recognize the severe budget pressure and Mr. Dickinson and I absolutely agree that we must have an even more cooperative approach between DOD and the Congress. I am perfectly willing to be completely open about our views of things and how we go about it and work with you and the staff to get there.

I would like to submit for the record my statement for the fiscal year 1987 Department of Defense program for Research and Development and continue with a brief summary of what I have said there.

Mr. PRICE. The full statement will be accepted for the record.

Mr. HICKS. I might also add that both the C³I and SDI programs are included in the $42 billion, those programs are separately handled by two different departments in the Department of Defense, Assistant Secretary for C3I, Donald Latham, who will appear before you at a later date, and General Abrahamson, who will be talking about SDI.

I will be glad to answer any questions about my relationship with those matters but they are truly in their areas of responsibility.

I would like to begin by talking about our strategic force modernization and in that specific area discuss the sea-based leg of that Triad which is our most survivable leg. The seventh Trident submarine began sea trials last September. The sea trials indicate it is going to do very well. The Trident II (D-5) missile is on schedule and will remain on schedule if the budget requests are met. Those schedules are flight tests in 1987, and an IOC in 1989.

Because of the Gramm-Rudman cuts in 1986, however, the Navy now considers meeting those dates ambitious.

In the air-based leg of the Triad, we have a very successful advanced cruise missile that is moving ahead very well and it will of course go on the B-52 and later on the B-1B. By mid-1988 we will have all the 100 B-1Bs delivered. The advanced technology bomber is doing extremely well, it is on schedule, and we expect it to meet all of the expectations we had planned for it.

I might add there has been a lot of unfortunate misinformation about a comparison between these programs lately in costs and other issues which at some point in another hearing we will try to address. I might add though, that I am authorized to say that the program unit cost of an ATB in constant year dollars, for example 1981, is within 2 or 3 percent of the same valuation for the B-1B.

So, some of the outlandish numbers you are hearing from the press about the cost of the system are not correct.

Mr. DICKINSON. Say that again, I am not sure I understand what you mean.

Dr. HICKS. If we take the program unit cost of an ATB bomber and let me use a constant year, in 1981 dollars, and compare it to the program unit cost of a B-1B in 1981 dollars, the costs are within 2 or 3 percent of each other. That is our best estimate at the present time.

Mr. DICKINSON. You don't mean growth, you mean actual unit cost?

Dr. HICKS. I am talking about actual unit cost.

Mr. DICKINSON. All right.

Dr. HICKS. In land-based leg of the Triad, we have had 10 very successful flights of our Peacekeeper missile. We are continuing to work as you have pointed out on basing options for the Peacekeeper, both superhard and others. Superhard now means 25 to 50 times harder than the Minuteman silos we now have.

The main issue in the basing of the Peacekeeper, is affordability, and that is the issue that we have to watch carefully. There is no doubt in my mind that we can build a completely survivable missile, the question is can we afford the trades as they up their offensive capabilities and we have to up our defensive capabilities.

The small ICBM is scheduled to enter full scale development this fall after it proceeds through DSARC II. It is scheduled for this fall.

I might discuss for a moment, Mr. Dickinson, the point you made about MX and where I think the administration's position is, and certainly what I believe.

About 3 years ago, the Scowcroft commission conducted a study and recommended, what I thought and what I believe the Nation thought, a program that we could live with that could keep our ICBM, land-based program on course. If I can recount that, it was that we would have 100 MXs in Minuteman silos as a first cut. Now, ignoring the fact that they will at some point be less survivable than we would like, I want to say that that would still be a magnificent deterrent against the Soviets starting anything in the nuclear area.

The next part of the recommendation was to continue to find a cost-effective basing mode for MX. To try to persuade the Soviets to go into arms control discussions that would be helped by having a small ICBM mobile missile single warhead, with the idea that we would have less first-strike capability from that group of missiles, that they would be quite survivable because they were mobile, and that they would not in fact, present a major target.

I think that the administration has continued to support what we all had agreed to then. In my mind, despite what I recognize and hear from my friends in Congress both in the House and the Senate, about MX, it is still the most effective way for some time to maintain our capability. We could put another 50 MX missiles in Minuteman sites for $2 billion and have another 500 warheads.

Mr. PRICE. Mr. Battista wants to ask a question.

Mr. BATTISTA. Dr. Hicks, I guess it was when the Scowcroft commission had been conducting its study they invited Mr. Dickinson and I to present some views on strategic modernization and at the time we talked about 50 MX missiles and established, Mr. Dickinson you may remember, that there was no real military requirement for 100 or 50. In fact, the number was substantially greater than that.

Dr. HICKS. The requirement was greater than that.

Mr. BATTISTA. No, that is basically the Air Force had established that you really needed several hundred in terms of the military requirement. They had agreed that 50 was probably a politically militarily acceptable figure.

At the time the conversation went along the lines well, if you want 50 you better ask for 100. I don't know what rationale they used for ultimately settling on 100, but that is what we talked about back then.

In fact, the only reason for the 100 was economic. I think the original numbers were $14.2 billion for 50 and $16.8 for 100 if I remember correctly. So it was more economic than it was military.

But regardless, that is history. Congress has sort of gone along with to a large extent with the Scowcroft Commission findings. But what is troublesome is why did the administration in its preliminary proposal to the Soviets offer up Midgetman? That was the first thing they offered up on the agenda. That doesn't seem to make sense, because really as long as both sides could count holes deterrence will be rather subjective, and the arsenals will continue to grow whereas with the area dispersal system, you throw in the uncertainty that could be the epic of arms control.

Why did the administration offer Midgetman up just like that?

Dr. HICKS. I think your premise is wrong in the first place. I don't agree at all that we are in such great shape we wouldn't be better off if the Soviets didn't have SS-25's. I think that there are a lot of good arguments we can discuss in some other forum, as to who would be served best by having no mobile missiles. The issue of whether or not you can count holes totally ignores the issue of deception which is a possible way of handling the problem.

Now, it is a very complicated issue which involves all three legs of the Triad and we all know it is not simple to come to any easy conclusions. To go back to your point about the 50 versus 100, all I can go by is what is on the record.

I don't know anything about side deals or discussions under the table. All I know is what came out as an official document, I was briefed in those days by the commission itself, and it was 100 MX's. The fact that it is not enough has been clear to me and I have seen the real problem for the Air Force. The issue of offering up mobile ICBM's is an issue that I suggest that you really should talk to the Secretary or Mr. Perle about rather than me.

I personally feel that we have a very serious threat to us in the SS-25, a missile that weighs somewhere in the 70,000 pound range, has the capability of being MIRVed with three warheads and presents difficulties in terms of its positioning.

So I suspect that if I had to make a trade in terms of deterrence I am not sure how I would come down. We can rest assured that whatever comes out of our offers the Soviets will not accept it unless it is to their benefit, so I wouldn't worry too much about that.

Mr. MCCURDY. Mr. Chairman, I was just curious about the procedure. Dr. Hicks has a formal statement. Why don't we let him proceed with the statement and refrain from questions until he finishes and then go in regular order so members have an opportunity to raise questions at that time, if that is acceptable.

Mr. PRICE. That is what we will do, if that is agreeable.

Dr. HICKS. Thank you.

I will try to get through this as quickly as possible, because I am interested in answering the questions.

In our conventional force area, there is an issue that I think we all recognize. First of all, right now we have a situation with our equivalence in nuclear forces that makes conventional deterrence take on a new importance. If we look at issues in the 1950's when we proceeded into the use of tactical nuclear weapons in order to, save money frankly, because we thought we were unable to raise sufficient forces and moneys to meet the Soviet threat in Europe. We now face a situation where we see our whole philosophy of deterrence turning away from nuclear deterrence, and we are going to have to find some way of replacing that philosophy with better conventional capabilities.

That will not be inexpensive.

In fact, as we go into these issues it is clear that defense in order to achieve conventional deterrence against the Soviet Union, will need more money, not less money.

Now, we have to rely upon technological leverage to meet the threats. This is not cheap either. However in many cases it is very cost-effective. I believe that one of the things we do wrong sometimes in our cost-effective analyses is not to consider the whole picture. We take limited portions of a system rather than the entire system. The effectiveness with which we can kill enemy weapons early in an engagement has a tremendous leverage which we often ignore when we begin to make trades on how much it costs to kill a given system.

We forget to include how much we save by what he doesn't kill.

So the use of Smart standoff weapons early in an engagement, even if they are expensive, may be very cost-effective.

Low observable technology, which I believe is one of the most important technologies of my generation frankly, shows great promise of rendering large areas of the defense capability of the enemy obsolete.

In addition to our new conventional initiatives which we have worked on very well with your staff, we are currently exploiting new capabilities to detect, track, target, and strike the enemy over 100 kilometers deep in his own territory.

One component of this package of development of programs, the Joint Surveillance and Target Attack Radar System, JSTARS, entered full-scale development in December. This is a program that provides us with all-weather targeting data and battle execution. This system with precision locating strike system and advanced ASARS will provide real-time intelligence information to theater commanders to prevent surprise in the event of an enemy attack, and provide targeting necessary to engage enemy forces long before they reach the front.

One of the factors that we have to be careful of as we go into these new and elaborate schemes for detection is that we really don't ignore the person in the front line, the forward air defense person has to have close-in data to fill in the situation. So that kind of sensor work has to be accomplished.

The long-range strike part of this package includes the Army's ATACMS which is in the final phase of DSARC's review and what I consider, if this review is satisfactory, will enter full scale development. ATACMS has interesting applications also in our relationship with NATO countries, and their desire to get into the program with us.

Also included is the Air Force's and Army's Joint Tactical Cruise Missile System, JTACMS now in advanced development.

We are also continuing our large conventional force modernization. Our force modernization includes ongoing acquisition of new systems, product improvements such as Abrams M–1 tank and the Bradley fighting vehicle.

The technologies involved in hypervelocity missiles, both air-to-ground and ground-to-ground, and Fog–M, offer promising new concepts. The latter concept was developed by an extremely capable person in an Army laboratory.

In the air warfare arena, we have a number of acquisition programs under way to improve our capabilities to improve our missions, and here I include such things as the air-to-air missile AMRAAM which is now at the top of the Air Force's priority list;

the low-altitude targeting and navigation infrared system for night lantern, and we are in the early concept development of an advanced tactical fighter for the Air Force and another attack aircraft for the Navy.

I would like to make a statement about that issue that I think is important at this point.

There has been some concern expressed in the past year about the fact that there perhaps should be just one fighter that can be used by both the Air Force and by the Navy to do these advanced missions. These advanced missions will of course require the best of everything that we have, including Stealth and taking advantage of our new powerplants.

I think that generally speaking, it is now believed—I certainly have always believed it—that it is impossible to have a swing fighter for the kind of things we are talking about. We will have to end up with two fighters, an advanced air superiority fighter and an advanced attack aircraft.

There is no reason, however, why those two programs cannot be used to serve both services. I have talked to both the Secretary of the Navy and the Secretary of the Air Force about that and they are now in the final stages of agreeing to a MOU which will allow that to happen.

Let me provide some insight regarding the concept.

What we would do is try to make certain that we don't fall into a trap of previous developments like this, where one of the Services pulls out because they do not agree with what they see in terms of the aircraft that they want. We have an example of that in the F-111 which we all remember so well.

The F-4 is a good way to talk about this subject. The F-4 was a Navy aircraft which the Air Force eventually accepted. Initially, although it received a lot of improvements such as locking the wings and lightening the landing gear no structural changes were made in the aircraft.

And the aircraft was successful.

There was unnecessary weight in that land-based aircraft, however, that affected not only performance but also the range, cost, maintainability, and reliability. Some years ago I was involved in a study of the F-4. We found that if we had decided to take the F-4 and put some development money into it—in those days a few hundred million—and changed the airplane by lightening the structural load behind the landing gear, changing the wings, but using the same subsystems, the basic things that cost money when we develop an aircraft from the start, we could have had an aircraft that met Air Force requirements much better than the aircraft that they got and saved about $1.5 billion of development cost.

So what I am talking about here is to begin the Navy program with the Navy doing what they have to do, knowing what they want in that aircraft, and the Air Force doing the same. However, we would have some good design people from the Navy involved in the Air Force program and vice versa. The purpose would not to be to interfere with the program, but as it proceeds, to look for things that might make it easier when the time comes to change that aircraft into the other Service's aircraft. For example to say, if you move this bulkhead a few inches this way it would help me later on. If it doesn't effect the performance of the aircraft for the prime service then it could be done.

Later on, when the aircraft is in the service for which it was primarily built, it could go into a development phase which might cost $1 billion. But that is much less expensive than it would be to begin a new aircraft.

You would have common avionics, common engines, et cetra. Even today, we are working toward the use of common avionics and things of that sort on the two different aircraft.

So this extension of what we are accustomed to already, I believe, would give us two exceptionally fine airplanes for both Services that would save the American taxpayer a considerable amount of money and give us the kind of performance we need.

We have several programs under way in the naval warfare arena to expand and improve the defense of our carrier battle groups, to improve our ASW, and to enhance the capability of our attack submarines. One of the good examples is the development efforts in the SSN-21, which will be a fine program that will be going into a DSARC-type review in about 1 month.

In the chemical deterrence area, I am pleased that the Congress has done a magnificent job of approving the chemical modernization via binary weapons and that development is a vital component to the maintenance of our overall deterrent capability. We are also moving ahead rapidly to destroy stocks of old chemical weapons.

We are continuing our work to demonstrate hypersonic flight technology needed for the aerospace plane. I have been reluctant to make that a big issue because I think we have about 3 years of difficult work on the engine to make sure that it will do the job. So it looks excellent. The engine looks very good.

We plan to have two different contractors working on the engine. We must do better in structural design and in some materials than we have done.

All of this should come together in about 3 years or less. At that point, we could make the decision whether to proceed or not on a research plan.

In support of our basic research needs, we have initiated with the support of Congress the University Research Initiative to work with universities to conduct research vital to our national defense objectives.

In our science and technology program, we have conducted basic and applied research to maintain our technological lead over our potential adversaries. Among these are the Strategic Computing Program headed by DARPA, the very high-speed integrated circuits, VHSIC Program, that is handled out of my office, the Propulsion Technology program, and the Advanced Aircraft Technology Program.

Our overall policy, of course, is to reduce duplicative efforts and draw on the technology and capacity of our allies to field the best and most cost-effective weapons possible. We have been assisted a great deal by the Nunn amendment, it has been very helpful to us.

I guess evidence of our progress in achieving our success is that we have agreed to about nine critical deficiencies for hardware and an approach to pursue correction. In fact, I will be leaving for

Europe the 24th of February for another Four Power and then CNAD meeting on that subject.

I will conclude my summary, with a brief reference statement of important management initiatives that affect my office.

I am not a fan of oversight. I am not a fan of auditing. In a factory, or in an engineering department, we use inspectors to find faults. We don't expect that they are going to be able to produce the aircraft. We don't expect them to be able to manage the aircraft.

So the success of a weapons system depends upon the quality of engineers who design it, detailing design and quality management of those who put it together and can put it out the door.

We have people along the way to check to see that the right things do happen, that check is an important check and we recognize that because that ensures we are doing the right thing.

Every time we put a check on a check, of course, oversight on oversight, we do absolutely nothing to help us with our basic mission which is to get a good piece of hardware in the hands of our serviceman.

USDRE has a unique situation in oversight in some ways. First of all, we are charged in the Department of Defense with R&D oversight on everything but almost more importantly, since the staff generally is designed to help the policy and then make certain that policy is carried out, the Office of the USDRE can get involved very early, that is our job, get involved in DSARC "0", through DSARC II and so on.

And I hope we can get more involved with the Services so that we have an understanding of their objectives. An understanding of what those objectives are will lead us, in terms of military requirements, to understanding of what we must do in terms of military specifications to weapons systems that we must produce to meet those objectives. So we can, with our group, make that a constructive and creative experience.

Over the past several months we have assembled an excellent, and outstanding, new management team. I am as proud of that team as I am of anything I have had when I was in industry. They are first-class people, with exceptional professional credentials, all of whom are making considerable sacrifices individually and financially to come and to do what they think is right.

As you meet them over the next several weeks, I am sure that you will join me in my judgment that they are very, very capable people and under their leadership our RDT&E resources will be ably managed because no matter what you have, no matter what you have in an organizational structure, the quality of the people is what really finally counts.

That concludes my summary. However, before I answer questions, I would like to discuss a couple issues that you raised in your letter and I should note, however, that the topics are so broad in some ways that they could easily be the subject of [illegible] [illegible]. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] of the overall budget setting process within the Department.

Nevertheless, let me try to briefly address some of these issues and I will be happy to respond in depth at this time or for the record if you have any additional questions.

First, preparation of the RDT&E budget. Basically the RDT&E budget, like the rest of the DOD budget, is prepared in the context of overall resource allocation guidance from the Secretary of Defense. Priorities are established for readiness, sustainability, modernization and force structure expansion both for the mid and long term. Our RDT&E budgets are established to reflect these priorities as given to me.

Second, regarding general policy. Our general policy for force structure requirements does not call for any arbitrary or fixed division between strategic and conventional programs. To maintain our deterrent posture, we must pursue a funding strategy for RDT&E that allows us to exploit the required technologies.

In the strategic arena, this means missile base survivability, small ICBM, ATB, Trident II (D-5) program and SDI. In the conventional arena, it means exploiting technology to maintain the qualitative edge necessary for deterrence of quantitatively superior forces.

I have already discussed our strategic and development programs, but I will be happy to answer any questions you have on that.

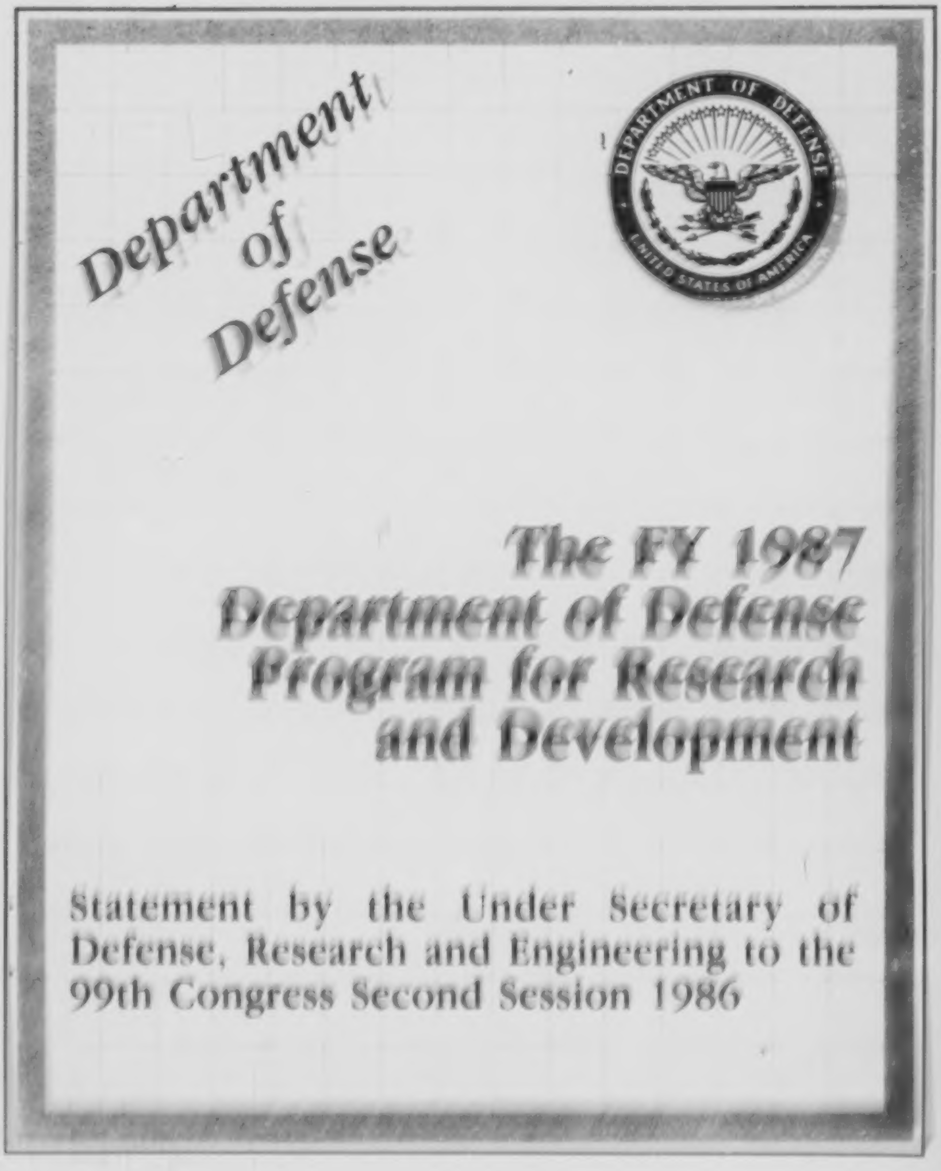
On the subject of testing, our overall theme has been quality testing and independent objective reporting of test results in order to support the acquisition and decisionmaking process.

There is no one in USDRE that has a desire to hide anything about weapons systems. The DOD directive that is being revised, is being revised to reflect these priorities and emphasize the need for realistic operational testing.

The same principles are also being applied in our joint Live Fire Test Program for tanks, infantry fighting vehicles, and aircraft.

Thank you, gentlemen. That concludes my remarks and I am prepared for any questions you might have.

## PREPARED STATEMENT OF HON. DONALD A. HICKS



Department
of
Defense

The FY 1987
Department of Defense
Program for Research
and Development

Statement by the Under Secretary of Defense, Research and Engineering to the 99th Congress Second Session 1986

# The FY 1987 Department of Defense Program for Research and Development

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# I. INTRODUCTION AND OVERVIEW

## RESOURCE REQUIREMENTS

The FY 1987 budget request for research, development, test and evaluation contributes to a sustained effort to strengthen U.S. national security. It encourages and exploits technological developments for force modernization and provides continued technological advances to meet future threats.

Today, as a result of the Administration's judicious application of increased resources for defense, our forces are more capable of deterring aggression because of force modernization achievements and high leverage capability improvements resulting from the exploitation of our technological strength.

Notwithstanding these accomplishments, much remains to be done. Our FY 1987 Research and Development, Test and Evaluation (RDT&E) budget request will provide, within the limits of previously agreed-to minimal near term growth, the continuation of a process that is yielding essential improvements in our national security.

To accomplish these important objectives, we are presenting an FY 1987 RDT&E budget request of $42 billion. This represents 13% (12% if the Strategic Defense Initiative (SDI) is excluded) of the total DoD FY 1987 Budget Request. We believe that this budget request is a reasonable share of the DoD's total, and, within it, we have tried to provide balanced allocations among the competing demands for RDT&E resources.

## R&D THREAT ASSESSMENT

The USSR devotes approximately 16% of its Gross National Product (GNP) to defense as compared to our own expenditure of about 6% of GNP. The military Research and Development (R&D) portion of Soviet investment has increased in real terms at an average rate of about 4% for each of the last 20 years. The Soviets are using these resources to exploit technology across a wide range of military missions. Their introduction of approximately 200 major systems every ten years, as well as a significant number of lesser modified systems for the past three decades, is convincing evidence of the intense and pervasive Soviet military development effort. Our intention has not been to match the Soviets weapon for weapon, but to continue to build upon our technology advantage to neutralize the Soviet numerical advantage.

The tremendous imbalance between the Soviet Union and the U.S. in the production of military hardware remains of great concern. As shown in Table I-1, the Soviets have maintained their significant numerical advantage in the production of military equipment in most weapon classes. The production of our NATO Allies offsets some of this imbalance, but the Warsaw Pact still enjoys significant numerical superiority.

The extent and thrust of the Soviet research, development, and acquisition

**Table I-1. Production Ratios of Selected Weapons for NATO and Warsaw Pact Armed Forces, 1981-1985***

| CATEGORY/ WEAPON | 1981-85 Production Ratio | | 1985 Production Ratio | |
|---|---|---|---|---|
| | USSR/U.S. | WP/NATO | USSR/U.S. | WP/NATO |
| **Strategic** | | | | |
| ICBMs | 700/0 | 700/0 | 100/0 | 100/0 |
| SLBMs | 1.4/1 | 1.3/1 | 1.4/1 | 1.2/1 |
| SSBNs | 1.3/1 | 1.1/1 | 2/1 | 1/1 |
| **Ground Combat** | | | | |
| Tanks | 3.0/1 | 2.0/1 | 2.1/1 | 1.8/1 |
| Artillery (100 mm and over) | 9.5/1 | 6.4/1 | 12.3/1 | 7.3/1 |
| **Ships** | | | | |
| Major Surface Combatants (over 900 tons) | 0.7/1 | 0.5/1 | 1/1 | 0.8/1 |
| Attack Submarines | 1.4/1 | 0.9/1 | 2/1 | 1.2/1 |
| **Aircraft** | | | | |
| Tactical Combat Aircraft | 1.7/1 | 0.9/1 | 2.2/1 | 1.0/1 |
| Military Helicopters | 2.7/1 | 1.1/1 | 2.4/1 | 2.2/1 |

* Does not include items produced for R&D.

effort intensifies the U.S. need to sustain modernization efforts and to further exploit our technological advantages. In addition, the competitive forces of a free society which stimulate innovation are important in keeping the Soviets from eroding our strength through their massive investment effort. In this regard, emphasis by the commercial sector on R&D investment has helped to limit Soviet versus U.S. asymmetry in expenditures for military research and development.

Our research and development program is designed to ensure the military capability to counter the threats posed by the Soviet Union and its Warsaw Pact Allies, as well as other potential adversaries. Our continuous process of threat assessment and evaluation of our capabilities to deal with the threat is an important component of our efforts to ensure that scarce resources are allocated to the highest priority areas.

## RDT&E PROGRAM DEVELOPMENT

FY 1987 RDT&E investments are consistent with this Administration's overall defense priorities:

- To enhance nuclear deterrence, we are modernizing our strategic nuclear capabilities and their command and control assets.

- To increase our conventional deterrence, developments are stressed that will multiply conventional force capability and raise the nuclear threshold.

- To strengthen readiness and sustainability, the reliability and maintainability of weapons and support systems are being improved.

- To support the Department's emphasis on recruiting and retaining quality people, we are insisting on system designs that enhance the "person-in-the-loop" contribution to system performance.

- To maintain and revitalize our alliances and obtain greater returns from our combined resources, we are increasing emphasis on cooperative research and development with our allies. Specifically, we are directing a major part of this emphasis to early deployment of systems employing emerging technologies.

The remainder of this chapter will highlight the important elements of our program.

### Strategic Force Modernization

We are proceeding with a force modernization program that is yielding significant improvements to our strategic triad.

We continue to be pleased with the progress of the modernization of the sea-based leg of the triad. The seventh Trident boat began sea trials in September, and our Trident II (D-5) Submarine Launched Ballistic Missile (SLBM) development program is meeting its objectives. An aggressive flight test program will begin in 1987, with the Initial Operational Capability (IOC) goal established for late 1989.

The capability of our strategic bomber forces will be significantly enhanced with the delivery of all 100 B-1Bs by mid-1988. In the meantime the effectiveness of our B-52 fleet has been augmented by equipping it with over 1500 Air Launched Cruise Missiles (ALCMs).

The next few years promise major improvements in the bomber leg of our triad. Deployment of the Advanced Cruise Missile (ACM), with its added range and improved survivability, will increase the capability of our B-52s to reach Soviet targets from extended ranges. Later employment on the B-1B will enable the B-1 to transition to an effective shoot-and-penetrate role.

As Soviet defenses become more capable, however, we will rely increasingly on the Advanced Technology Bomber (ATB), with its low observable technologies, to maintain penetrating bomber effectiveness against critical Soviet targets, such as the growing number of strategic relocatable targets. Details of progress and schedule for the ATB program remain classified, but, to date, no significant technical problems have emerged to slow our work. The program is proceeding smoothly toward the first ATB test flight and a production decision.

For the third leg of our strategic triad, land-based Intercontinental Ballistic Missiles (ICBMs), the immediate future may be something of a crossroads. Three years ago the Scowcroft Commission recommended the deployment of 100 M-X missiles (the Peacekeeper) in existing Minuteman silos, the development of a Small ICBM (SICBM), and the aggressive pursuit of strategic arms control. Now, as we enter 1986, we have Congressional approval for only 50 Peacekeeper missiles, the requirement to develop an alternative survivable basing mode for a second 50 Peacekeepers, an ongoing advanced development program for the SICBM, and we have not yet completed the difficult process of achieving strategic arms control with the Soviet Union.

To date, we have had ten successful flight tests of the Peacekeeper, and the program continues on schedule. Work continues on the SICBM with plans to enter full scale development this year. In parallel, we are proceeding with our evaluations of survivable basing modes for both missiles. Significant potential exists with the hard mobile concept for the SICBM and on superhard silos for Peacekeeper. SICBM in hard mobile basing can be made survivable. The main challenge is its affordability.

The quickest and least expensive way to improve ICBM effectiveness is with Peacekeeper. The minimum cost approach is the original Scowcroft recommendation--deployment in existing Minuteman silos. However, additional survivability can be obtained by deploying the Peacekeeper in superhard silos. This will force the Soviets to employ low confidence tactics or to develop specialized warheads for their ICBMs if they wish to threaten Peacekeeper. We are also examining several additional basing modes including the "carry hard" basing mode. This mode deceptively moves encapsulated missiles among many low cost aim points. If "carry hard" proves feasible, we could provide additional survivability against any foreseeable Soviet threat.

The future therefore confronts us with a number of challenging issues that must be addressed. We hope that developments this year, including the report of the Defense Science Board Task Force on the Small ICBM, will provide us with needed insights regarding the best approach to continuing modernization of our land-based ICBMs.

These efforts to modernize U.S. strategic forces should go a long way toward restoring the balance between U.S. and Soviet offensive forces. At the same time, however, the USSR is pursuing a vigorous program of modernization that threatens to outstrip us if we do not continue to execute our current plans and fully deploy the systems now in development.

## Conventional Force Modernization

As NATO and the Warsaw Pact move closer to nuclear parity, we can no longer rely as heavily on our nuclear arsenals as the mainstay of our deterrent posture. It becomes critically important to build and modernize our conventional forces to complement our strategic forces. Our conventional forces must be sufficiently robust so that the chances of nuclear escalation are reduced.

Several recent developments suggest that conventional deterrence will become increasingly important to us and our allies. In the strategic defense arena, the President's SDI research program has the potential to contribute to protection against a first strike and, combined with limits on offensive weapons, to a common defensive posture for both the U.S. and the USSR. If we move toward an era where defensive systems dominate over offensive ones, we will be required to rethink our whole approach to deterrence. Our defense policy will have to evolve to reflect such changes. In this context, an increasingly important objective for research and engineering will be to exploit technology that can increase our capability to maintain a credible conventional deterrent.

We are currently exploiting emerging technological capabilities to detect, track, target, and strike the enemy deep in his own territory. Elements of the SDI program such as battle management, target information transfer, and kinetic energy weapons research will yield results useful for improving our conventional capabilities as well.

Across a broad front, we are aggressively pursuing the technologies associated with reducing the natural signature (electronic and acoustic) of platforms. The design of systems to achieve this involves the blending of numerous factors including performance, cost, and survivability. Signature control technology offers a means of making large portions of the threat obsolete by drastically limiting the ability of enemy sensors to acquire, track, and provide the information required for engagement of U.S. weapon platforms when they are countering enemy attacks. In the future, it will be increasingly important for us and our allies to use these and other developments to achieve the force multiplier effects necessary to strengthen conventional deterrence.

An important element of our conventional force modernization program is our "Conventional Initiatives" package of developmental programs that will allow us to both see and strike the enemy throughout the depth of the battlefield. This set of programs include advanced long-range sensor systems such as Joint Surveillance and Target Attack Radar System (JSTARS), Precision Location Strike System (PLSS), and Advanced Synthetic Aperture Radar System (ASARS) that will provide real-time intelligence information to the Theater Commanders to prevent surprise and, in the event of an enemy attack, provide targeting information on enemy forces so that they can be engaged long before they reach the front.

The long-range strike part of the Conventional Defense Initiative [illegible] NATO's defenses.

In addition, we are continuing our conventional force modernization program which encompasses a wide range of projects designed to greatly improve the warfighting capabilities of our land, air, and naval forces.

For land warfare, modernization continues at a high rate emphasizing the introduction of new armor, mechanized infantry, anti-tank, fire support, and air defense systems. The Abrams M1A1 tank, with its 120mm gun, will go into full rate production this year. Production continues on the Bradley fighting vehicle with live-fire tests planned this year that will provide the basis for vehicle survivability improvements. [illegible] the Army is undertaking a comprehensive program to upgrade forward area air defense in the wake of the Sergeant York cancellation. In new technology developments, the hypervelocity missile and the Fiber Optic Guided Missile (FOG-M) offer exciting new concepts for greatly increasing effectiveness against many target classes.

For air warfare, we have acquisition programs underway to improve our capabilities to perform counter-air, air defense suppression, and air-to-ground strike missions. For counter-air, we have underway a series of product improvement programs that include engine, sensor, and avionics upgrades for the F-14, F-15, and F-16, and continued production of improved versions of [illegible] Tactical Fighter (ATF) which will provide a long-term capability [illegible] air combat [illegible] the Soviets in air superiority.

For air defense suppression, we are acquiring the PLSS to locate air defense emitters for targeting by other systems, upgrading the Air Force EF-111 and Navy EA-6B to enhance radar jamming capabilities, and upgrading the F-4G (Wild Weasel) so that it can fully exploit the capabilities of the High Speed Anti-Radiation Missile (HARM).

For air-to-ground missions, we are developing the F-15E for long range interdiction missions with deliveries planned next year. We are fielding the Imaging Infrared (IIR) version of [illegible] in advanced development, will provide the capability to accomplish many strike missions with different warhead modules on the target. These new strike systems are designed to increase launch platform survivability and enable more effective operations in a high threat environment.

For naval warfare, we have important ongoing acquisition programs designed to expand and improve the defense of our carrier battle groups. In Anti-Air Warfare (AAW), the Aegis cruiser and DDG-51 guided missile destroyer programs will provide substantial improvements in protection against air threats. To improve our capability [illegible]

In addition, the Navy [illegible] continuing a broad strategy for regional air defense, and (3) identifying advanced programs and technologies necessary to counter the improving Soviet submarine threat.

## Chemical Deterrence

For the first time in over 16 years, the United States will be able to upgrade its chemical arsenal to provide essential deterrence. Congressional approval to proceed with chemical modernization via binary weapons production [illegible]

## Science and Technology

The main purpose of the Science and Technology (S&T) program is to [illegible] development. Among priority efforts are the Strategic Computing program, the Very High Speed Integrated Circuits program, the Aircraft Propulsion Technology program, and the Advanced Aircraft Technology program. In strategic computing, artificial intelligence capabilities are being developed for a variety of applications. The aircraft programs strive for major increases in capability in propulsion, overall operational improvements, and survivability. In addition, we are also continuing work on joint programs with NASA for exploration of the technology [illegible]

[illegible]

## International Cooperation

[illegible] existing efforts to improve conventional defenses. This further underscores our joint commitment to the kind of cooperation that must take place in an era of constrained resources to address an undiminished Soviet threat.

Implementation of cooperative agreements will be facilitated by the action that the U.S. Congress has taken in support of NATO armaments cooperation. This support includes enactment of the authorization legislation commonly referred to as the Nunn and Quayle amendments. The authority contained in these initiatives provides us in the Department of Defense with a concrete framework in which to work in [illegible] important [illegible] improve[illegible]ation.

[illegible] pursue [illegible], with [illegible]. With [illegible]lize a [illegible]rein a [illegible] result. [illegible] Senior [illegible]ize and [illegible]m of [illegible]pan.

## [illegible]S

[illegible]ish the [illegible]ve also [illegible]gement [illegible] undertaken a number of [illegible] initiatives.

### USDRE Management

Within OUSDRE over the last several months, an intense recruiting effort has culminated in the selection of five new deputy undersecretaries. We have also named a new Director of the Defense Advanced Research Projects Agency (DARPA) and a new Assistant to the Secretary of Defense for Atomic Energy will soon be in place. All these individuals come to their positions of government service with exceptional professional credentials. All have made substantial personal and financial sacrifices to serve the Department of Defense. Under their leadership, the resources made available for research, development, test and evaluation will be ably managed.

## Emphasis on the Defense Acquisition Improvement Program

Over the years in defense acquisition, there has been a tendency to try to solve the very complex problems inherent in acquiring complex systems with somewhat simplistic solutions. In recognition of the need for a more finely-tuned approach, this Administration launched the Defense Acquisition Improvement Program (DAIP). Within OUSDRE, several of these initiatives are of important management concern. These include Program Stability, Competition, and Industrial Responsiveness.

In order to promote greater affordability and stability for our overall defense program, all new starts are carefully reviewed to ensure that only those of highest defense priority are allowed to compete for funding.

We also pursue initiatives to enhance program stability during development through "program baselining." Each of the Services has implemented a management review program which establishes a system cost, schedule, and configuration baseline. Proposed major changes to the approved baseline must be reviewed and evaluated for need and cost efficiency. As a result, we expect to discourage costly arbitrary program changes.

Competition is a means of achieving more for the defense dollar. Competitively awarded contract dollars increased $14 billion in FY 1985. We also awarded 71.6% of contract actions competitively in FY 1985 versus 68.1% in FY 1984 and 52.6% in FY 1983.

Perhaps more importantly, however, from the perspective of an USDRE, is the need to emphasize competition as a way to generate technology options to meet our mission requirements. By obtaining competitive technological approaches at the front end of the acquisition process we can ensure that our investments in R&D are highly leveraged. In summary, we will promote competition where it makes sense both to achieve cost savings and to accomplish other desirable objectives.

We are actively encouraging our R&D program managers and our R&D contractors to consider industrial base issues during all phases of R&D. We need to maintain a healthy, viable industrial base as an important element of our deterrent.

## Joint Program Management

Making joint programs succeed takes a concerted effort by Congress, the Office of the Secretary of Defense (OSD), the Office of the Joint Chiefs of Staff (OJCS), and the Services. DoD uses special high level management bodies to address the opportunities and challenges of joint program development and management. DoD also continues to initiate R&D actions which enhance affordability in addition to meeting interoperability requirements and improving logistical efficiency. Our search for opportunities includes: surveying multi-Service mission requirements for common functions or related threats; resolving unnecessary differences in requirements and specifications; integrating requirements to get more economical production rates and more competitive acquisition; and developing common, simplified training and logistic support bases.

We support strong Joint Chiefs of Staff utilization of the Joint Requirements and Management Board (JRMB) to identify joint military requirements and candidates for joint research and development, and to resolve Service requirement issues that may arise after joint programs are initiated. The JRMB is off to a good start and will continue to be helpful in solidifying joint programs.

Currently, there are more than 150 joint programs in various stages of development and procurement. In addition, resolution this past year of inter-Service issues regarding JSTARS and the Joint Service Advanced Vertical Lift Aircraft (V-22) provides two examples of the commitment of OSD leadership to effective joint progam management.

## Other Initiatives

We are also supporting other efforts such as the Deputy Secretary's Acquisition Streamlining Initiative. This initiative to tailor development and procurement specifications during new system reviews is resulting in the elimination of requirements that are overly ambitious and uneconomical.

# II. U.S.-USSR RESEARCH AND DEVELOPMENT BALANCE

## INTRODUCTION

This chapter contains an overview assessment of the U.S.-USSR research and development (R&D) balance. Such an assessment is useful because:

- It gives us a broad view of where we have been and where we are going. It places our current defense R&D effort in context and highlights those trends that may require changing emphasis in future R&D programs.
- It alerts us to be on guard in areas where the USSR may be taking advantage of our open society to acquire advanced technology through legal and illegal means.
- It points to mission areas or weapon types where the U.S. or USSR face the prospect of replacing large quantities of aging equipment.
- It points to possible areas of high leverage, where relatively small investments can have major impacts.

The kinds of simple static balance comparisons that can be presented in an open publication have limitations: they omit critical areas of technology that must remain classified; they do not address the interactive dynamics of U.S.-USSR force acquisitions; and they cannot even begin to illuminate the potential outcomes of combat. Nevertheless, we feel such comparisons are useful because they foster public understanding of the issues to be considered in our FY 1987 budget and direct the attention of specialists to the threats and opportunities we appear likely to face in the 1990's.

The discussion in this chapter will focus on several broad areas. More detailed information by military mission area is presented in later chapters. Here are discussed: (1) defense resources--dollars and manpower devoted to defense in general, and defense-related

R&D in particular; (2) the R&D organizations and processes by which the U.S. and USSR turn new technology into deployed weapons; (3) the comparative levels of basic and applied research and development efforts; (4) the level of technology incorporated into deployed weapons; (5) the numbers of new and modified weapons developed and introduced into the forces in the last 25 years; and (6) the degree to which the technological improvements incorporated in those weapons reflect the Warsaw Pact's exploitation of Western advances.

Within the discussion of major mission areas in later chapters, data are presented on the major new weapons deployed in the mid-1980's, the major qualitative trends in modernization in the mid-1980's, and selected statistics on numbers of new weapons, inventory value of forces and aging trends.

## DEFENSE EXPENDITURES

In terms of overall spending the USSR is estimated to devote roughly 16% of its Gross National Product (GNP) to defense. This compares to 6% for the U.S. (Figure II-1). Our NATO allies contribute substantially to the common defense. The measurable contribution of the non-Soviet Warsaw Pact countries to the Warsaw Pact is limited. When measured in dollars, NATO defense expenditures exceed those of the Warsaw Pact (Figure II-2).

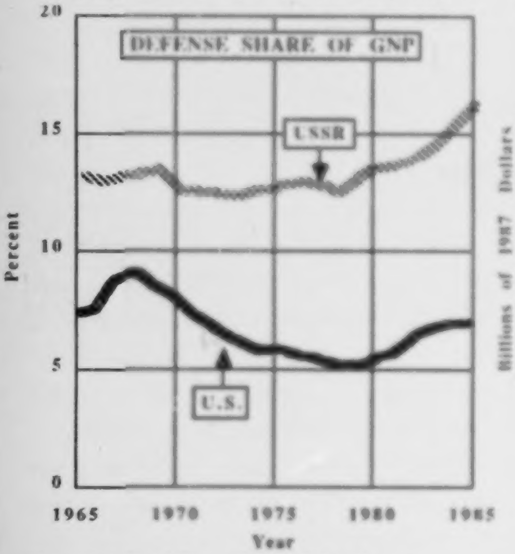


Figure II-1. U.S. and USSR Defense Spending as a Percentage of Gross National Product, 1965-1985

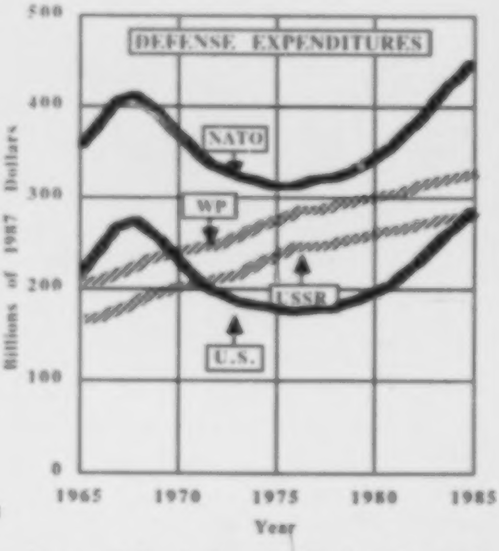


Figure II-2 Estimated Dollar Cost of NATO and Warsaw Pact Defense Activities, 1965-1985

The Soviets' commitment of resources to both military research and development and procurement has been enormous. Over the past 20 years the dollar cost of Soviet military investment (RDT&E, procurement and military construction) has increased at an average annual rate of 3%. Soviet military R&D activities alone have increased at about 4% annually. During the past ten years, growth in Soviet procurement has slowed, but its level has been so high that the estimated dollar cost of Soviet defense investment exceeded U.S. outlays by approximately $350 billion (Figure II-3).

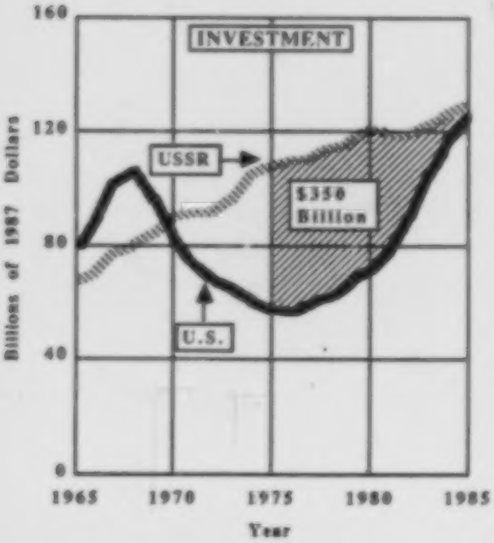


Figure II-3. A Comparison of U.S. Defense Investment Outlays with Estimated Dollar Cost of USSR Defense Investment, 1965-1985

The last decade has seen significant expansion in Soviet investment in those organizations that carry out military-related R&D. Despite such efforts, the recent strengthening of the U.S. military R&D commitment and its prospective continuation into the future represents a continuing response to Soviet military R&D. If they so choose, it will remain difficult for the USSR to close many already existing technology gaps, and new ones are likely to emerge. U.S. R&D expenditures have remained about 12% of Defense outlays since the late 1970's. Estimated Soviet RDT&E expenditures have risen steadily over the last 20 years. The impact of the Soviet R&D program has been to create a wide array of future options for exploiting existing technology across the broad range of military missions.

This Soviet challenge is qualitative and quantitative and requires that we maintain both a sustained modernization effort and a strong defense technology base to assure an acceptable balance of near and long term risks to national security. Our prospects for achieving such a balance are enhanced, in part, by our strong commercial technology base, which has helped alleviate the asymmetry in expenditures for military research and development.

The challenge presented by the growing Soviet military RDT&E program and the Warsaw Pact military industrial base has several dimensions. First, the Soviet military acquisition effort has traditionally been characterized by the highest national priority, centralized control in the execution of its plans, and long range program stability. High production rates and a deliberately evolutionary approach--routinely improving existing systems in parallel with the development of new systems--are also characteristic of the effort. Taken together, those approaches have led to steady, across-the-board improvements in military capability in all mission areas.

At times the independence and national priorities of NATO members mitigtate against an efficient weapons development process, whereas coordination of Warsaw Pact efforts entails coercion rather than the negotiation that occurs within the NATO alliance.

However, the Soviet acquisition program has weaknesses. These stem from three interrelated factors: the Soviet system lacks the flexibility and incentives inherent in free-enterprise economies with their many suppliers; they depend on Western accomplishments to point the way toward high-technology advances; and their domestic political priorities and age-old penchant for secrecy hinder the dissemination and application of scientific developments.

## WEAPONS R&D ESTABLISHMENTS

The USSR has recognized that leadership in science and technology plays a key role in maintaining world leadership--industrially, economically, militarily and politically. They have established a centrally controlled system to formulate and carry out their R&D programs and to manage the flow of research through its various phases--fundamental, exploratory and applied. The Politburo sets broad national R&D policies. Occasionally, it even initiates new weapon programs (e.g., atomic bomb and ballistic missile developments). The Soviets' strategy for the achievement of their R&D goals includes a high and steadily increasing level of resource investment, and encompasses essentially two approaches: (1) the maintenance of a large indigenous technology base to support military and industrial development, and (2) the acquisition and assimilation of Western technologies to reduce the time, cost and risk involved in new programs. The Soviet military RDT&E program is characterized by stability in funding, personnel, and program plans. Its steady growth continues.

Soviet military-related R&D is carried out in research institutes, design bureaus, and production associations--the same types of organizations involved in the Soviet weapon system acquisition process. In the USSR these organizations tend to be integrated vertically, which has led to many programs being conducted by highly specialized entities, often working in total (and sometimes self-defeating) isolation from each other (Table II-1).

Most Soviet research projects (military and civilian) are conducted in the research institutes, many of which are under the jurisdiction of the various Academies of Sciences. The overall number of institutes in the USSR has doubled from about 1,500 in 1960 to over 3,000 today. This reflects the steady expansion that has taken place in the Soviet research base and represents a significant capital investment and increase in capability. Over the past several years, the National and Regional Academies and other Soviet civilian research institutes have been assigned an increasing number of defense projects. About half of all R&D conducted in the USSR is now military-related, which compares to the roughly 30% of all U.S. R&D which is currently military-related.

The design bureaus are subordinated to the defense industrial ministries and play a critical role in technical innovation and development of advanced systems. Organizationally located between the research community and the production organizations, the design bureaus are

Table II-1. Major System Acquisition Functions and Primary Performers

| Functions | Performers | |
|---|---|---|
| | United States | Soviet Union |
| Research | Government Laboratories<br>Educational Institutions<br>Industrial Contractors | Academies of Science<br>Ministry of Higher and Secondary Specialized Education<br>Research Institutes* |
| System Development | Industrial Contractors | Design Bureaus* |
| Production | Industrial Contractors | Series Production Plants* |

*Subordinated to Defense Industrial Ministries.

responsible for developing new equipment, employing the best available technology that is consistent with system and production requirements. Their management approach features multi-year program funding, preplanned product improvement and early responsiveness to U.S. and NATO program developments. A small amount of exploratory research is performed by design bureaus.

Conglomerate organizations, called "production associations," integrating independent research institutes, design bureaus and production facilities are becoming the basic unit of Soviet military industry. These associations combine vertically a number of organizations under a single management and they can include some or all of the above types of independent organizations. The principal purpose of the shift to the association form of organization and management is to accelerate the pace of scientific and technological progress and to reduce the lead times required to bring new technology into production.

Despite major differences in their weapons development processes, full scale development times--from authorization of Experimental Design Work (OKR) in the USSR, or Full Scale Development (FSD) in the U.S., to Initial Operational Capability (IOC)--are close for the two countries. Major military systems in both countries take 8 to 12 years from the beginning of development until development is completed.

Military service-developed requirements keep Soviet system developers--the design bureaus--fully occupied. While the number of U.S. and Soviet system developer organizations is about the same (Table II-2) differences in approach have resulted in the Soviets pursuing a larger number of programs over time. Each Soviet organization has its own specialization(s), and maintains full employment with development proceeding at the stable level of effort the Soviets feel is needed to handle their long term military requirements. U.S. contractors, on the other hand, have a

**Table II-2. Number of U.S. and USSR Major Military Systems Developers***

| System Type | U.S. | USSR |
|---|---|---|
| Strategic Missiles and Space Boosters | 5 | 7 |
| Tactical Missiles | 10 | 9 |
| Aircraft | 12 | 9 |
| Ships | 9 | 6 |
| Satellites | 8 | 6 |
| Tracked Vehicles and Artillery | 8 | 7 |
| Radars | 7 | 8 |
| Total | 59 | 52 |

* Some involved in more than one system type.

more cyclical business. Available funding and employment fluctuate, dropping substantially when firms do not win new contracts. U.S. defense contractors draw from essentially the same pool of workers, who can, and do, move around among organizations. Steady full employment and uniform growth rates have allowed the Soviets to conduct up to three major development programs simultaneously in each major design bureau's product base. More than 200 major military development programs and a significant number of lesser modified programs are completed by the 50 major Soviet design bureaus, every ten years. In support of these developments, the Soviets have some 4500 research projects in process.

The Soviet Union has for years steadily increased its manpower allocated to R&D. It maintains a numerical superiority over the U.S. in full-time equivalent scientists and engineers engaged in R&D. This quantitative superiority, however, does not necessarily give the USSR the capability to out perform the U.S. in R&D. In many cases, Soviet capital investment has not kept pace with this growth in manpower, advanced equipment has not been provided, automated support systems are not available and as a result productivity may be lower. Moreover, the nature of Soviet society tends to stifle innovative and imaginative thinking--key elements in the successful pursuit of research. As a result, the Soviets use more manpower than does the U.S. to perform similar R&D activities.

## WEAPONS R&D PROCESSES

The U.S. and the USSR have stylized, formal weapons research and development processes that while structurally very different, are functionally rather similar. Both countries support a continuing military research program to identify, explore and develop the basic technologies necessary for the development of new weapons and the improvement of existing weapons. Both have formal requirements processes that specify needs for new weapons and support systems, based largely on threat and opportunity assessments. Both require formal documentation for each major phase of weapons development, including high level approval to invest resources before proceeding from initiation of a weapons program through to production and deployment. Both have well defined test and evaluation procedures which are implemented throughout development. As indicated earlier both take about the same time from approval of a major weapons development program through full scale development.

Despite these similarities in form and development times, there are many important differences between the weapons development environment and processes of the two countries. These differences involve: the methods of weapons oversight, review and approval; the industrial bases of the two countries and the environments in which the defense industries of the two countries operate; the research and system design management styles; and the relative emphasis on new technology. The differences between the Soviet and U.S. acquisition processes can be summarized by:

- National Management and Budgeting

- The Soviets have an established top level national weapons oversight organization, the Military Industrial Commission (VPK), that combines oversight and supervisory functions performed in the U.S. by the Department of Defense and the Congress, as well as some functions of the private industrial sector. Each major program phase decision is staffed through the VPK which reports to the Council of Ministers, and is documented in a decree which has the authority of law.

- The major development decision made to approve the resources required to proceed with Full Scale Development is the Defense Systems Acquisition Review Council Milestone II (DSARC II) in the U.S., and in the Soviet Union it is the Joint Decree of the Central Comittee of the Communist Party and the Council of Ministers. This is the first, and possibly only, major approval in the Soviet Union whereas it is the second of three major approvals in the U.S.

- U.S. resource commitments for defense programs are revisited on a yearly basis because of Congressional approval requirements, while Soviet resources are committed for the full program once directed by the issuance of a Joint Decree.

- A major segment of Soviet industry is dedicated to defense work, maintains full employment, and has top national priority on national resources; whereas U.S. defense contractors must compete for business in market conditions that have wide variations.

- The top level people involved in major weapon acquisition decision making remain in their positions much longer in the USSR than in the U.S.

- As a result, Soviet major military development programs tend to be much more stable and have greater continuity than U.S. development programs.

- System Design Management and Style

- Higher Soviet program security makes it more difficult for both other Soviet organizations and the U.S. to take advantage of Soviet knowledge and developments.

- The USSR has separate research, design and production organizations; in the U.S. the functions are generally integral to single contractors.

- The top priority of Soviet programs is to meet preset program schedules; while the top priority of U.S. programs is technical performance in order to win contracts.

- The U.S. tends to use new technology for each new system to provide maximum technical performance; the Soviets emphasize extensive use of technology transferred or acquired from the West to keep pace with the technology in threat systems, and use off-the-shelf components for producibility considerations to help meet the program requirements and schedule.

- Technology freeze occurs in USSR programs at the beginning of the Experimental Design Work (OKR) Development Phase (equivalent to Full Scale Development in the U.S.); while it occurs years later in the middle of Full Scale Development in U.S. programs.

The USSR emphasizes product improvements proceeding in parallel with new developments. This reduces the need for the Soviets to push technology in each development program since if the next program doesn't achieve desired performance, the one starting a few years later will come closer. In addition, the phasing of product improvements and new system developments allow full employment to be maintained and effectively used at the major design bureaus.

These similarities and differences between the U.S. and Soviet weapons R&D systems are discussed not because we should emulate the Soviet system, but rather because of what we can learn by observing their system more closely--how they are likely to respond to our initiatives, how to protect U.S. and allied technology, and how to improve our procedures and processes. On the last point--without sacrificing the edge we achieve by demanding intense competition--the U.S. clearly could benefit from a unified, long-term commitment from all of the decision makers involved in weapons procurement to maintain continuity and stability in major programs. Improved effectiveness and efficiency would be the result.

## TECHNOLOGY AND WEAPONS DEVELOPMENT

### Basic Research and Advanced Technology

We are now fielding systems using technologies that were developed during the late 1960's and early 1970's. We must now lay the technology foundation for those weapon systems that will be needed in the 1990's and the next century.

The products of the large Soviet R&D effort are of concern. Our S&T program, in addition to providing us weapons options, keeps us from being surprised by technological innovations and enables us to react relatively quickly to new Soviet weapons developments. Basic technologies that have potential for significantly impacting military capabilities in the next 10 to 20 years are compared in Table II-3. The U.S. is shown to have maintained its lead in most of the basic technologies critical to defense, although potential exists for the Soviets to gain ground in many areas where we now lead. It is essential that we maintain that lead in order to offset somewhat the great disparity in the quantity of equipment they have deployed.

Military technology is not useful unless it is incorporated into deployed military systems. The relative technology levels in deployed weapon systems are shown in Table II-4. These assessments deal solely with technology level and do not measure overall force effectiveness or the quantity of equipment deployed. Such effectiveness is dependent on other factors like doctrine, tactics, training and numbers deployed. The table shows, in aggregate, roughly the same level of deployed technology in land forces with the U.S. superior in the strategic, air, naval, and $C^3I$ areas. However, the number of weapon types tending toward equality or Soviet superiority represent a matter of concern--it has not always been that great--and we may be losing our lead as a result of higher Soviet R&D effort and their emphasis on acquisition of Western Technology.

### Introduction of Weapons

The large Soviet R&D program has borne fruit. One simple measure of the effectiveness of the U.S. and Soviet programs is the number of newly developed weapons, and major modifications or improvements introduced into the respective military forces. Over the last 25 years the USSR has consistently introduced more new

## Table II-3. Relative U.S./USSR Standing in the Twenty Most Important Basic Technology Areas*

| Basic Technologies | U.S. Superior | U.S./USSR Equal | USSR Superior |
|---|---|---|---|
| 1. Aerodynamics/Fluid Dynamics | | X | |
| 2. Computers and Software | ← X | | |
| 3. Conventional Warheads (Including all Chemical Explosives) | | X | |
| 4. Directed Energy (Laser) | | X | |
| 5. Electro-Optical Sensor (Including Infrared) | X | | |
| 6. Guidance and Navigation | X | | |
| 7. Life Sciences (Human Factors/Biotechnology) | X | | |
| 8. Materials (Lightweight, High Strength, High Temperature) | X → | | |
| 9. Micro-Electronic Materials and Integrated Circuit Manufacturing | X | | |
| 10. Nuclear Warheads | | X | |
| 11. Optics | | X | |
| 12. Power Sources (Mobile) (Includes Energy Storage) | | X | |
| 13. Production/Manufacturing (Includes Automated Control) | X | | |
| 14. Propulsion (Aerospace and Ground Vehicles) | X → | | |
| 15. Radar Sensor | X → | | |
| 16. Robotics and Machine Intelligence | X | | |
| 17. Signal Processing | X | | |
| 18. Signature Reduction | X | | |
| 19. Submarine Detection | X → | | |
| 20. Telecommunications (Includes Fiber Optics) | X | | |

* 1. The list is limited to 20 technologies, which were selected with the objective of providing a valid base for comparing overall U.S. and USSR basic technology. The list is in alphabetical order. These technologies are "on the shelf" and available for application. (The technologies are not intended to compare technology levels in currently deployed military systems.)

2. The technologies selected have the potential for significantly changing the military capability in the next 10 to 20 years. The technologies are not static; they are improving or have the potential for significant improvements; new technologies may appear on future lists.

3. The arrows denote that the relative technology level is changing significantly in the direction indicated.

4. Relative comparisons of technology levels shown depict overall average standing only; countries may be superior, equal or inferior in subcategories of a given technology.

5. These average assessments can incorporate a significant variance when the individual components of a technology are considered.

## Table II-4. Relative U.S./USSR Technology Level in Deployed Military Systems*

| System Type | U.S. Superior | U.S./USSR Equal | USSR Superior |
|---|---|---|---|
| **Strategic Warfare** | | | |
| Intercontinental Ballistic Missiles | | X | |
| Ballistic Missile Submarines | X | | |
| Submarine Launched Ballistic Missiles | X → | | |
| Bombers | X | | |
| Surface-To-Air Missiles (SAMs) | | No U.S. System Deployed | |
| Ballistic Missiles Defense | | No U.S. System Deployed | |
| Anti-Satellite | | | ← X |
| Cruise Missiles | X → | | |
| **Tactical Warfare** | | | |
| **Land Warfare** | | | |
| SAMs (Including Naval) | | X | |
| Tanks | | X | |
| Artillery | | | X |
| Infantry Combat Vehicles | | X | |
| Anti-Tank Guided Missiles | | X | |
| Attack Helicopters | X | | |
| Chemical Warfare | | | X |
| Tactical Ballistic Missiles | | X | |
| **Air Warfare** | | | |
| Fighter/Attack and Interceptor Aircraft | X → | | |
| Air-To-Air Missiles | X | | |
| Air-To-Surface Munitions | X → | | |
| Airlift Aircraft | X | | |
| **Naval Warfare** | | | |
| Attack Submarines | X → | | |
| Torpedoes | X → | | |
| Sea Based Aircraft | X | | |
| Surface Combatants | X → | | |
| Naval Cruise Missile | | X | |
| Mines | | | X |
| **Other** | | | |
| **Command, Control, Communications and Intelligence** | | | |
| Communications | | X | |
| Electronic Countermeasures/ECCM | | X | |
| Early Warning | X | | |
| Surveillance & Reconnaisance | X | | |
| **Training Simulators** | X | | |

*1. These are comparisons of system technology level only, and are not necessarily a measure of effectiveness. The comparisons are not dependent on scenario, tactics, quantity, training or other operational factors. Systems farther than 1 year from IOC are not considered.

2. The arrows denote that the relative technology level is changing significantly in the direction indicated.

3. Relative comparisons of technology levels shown depict overall average standing only; countries may be superior, equal or inferior in subcategories of a given technology in a deployed military system.

systems per year than does the U.S. (Figure II-4). They have also introduced more modifications than the U.S. In the past five years, the U.S. introduced around 4 new systems per year while the USSR, introduced about 10. Figure II-5 indicates new system introductions as a percentage of the total introduced.

The reasons for these differences are not entirely clear, but they probably include the following: the U.S. has tended to develop more multi-purpose systems, thus requiring fewer different systems; the U.S. has tended to make larger technological leaps from one technological generation to the next; and finally, even within a generation of weapons, the USSR has tended toward multiple approaches to meeting military requirements.

## Production of Weapons

Another measure of acquisition capability and ability to sustain that capability over the long run is the weapons production level. Figures II-6 and II-7 show production of weapons delivered by the U.S. and by the USSR, and by the NATO and Warsaw Pact alliances in total. Production FOR is that production designated for a country's or alliances own forces while production BY is the total output of a particular country or alliance (includes exports). Of the 14 weapon types shown, the USSR outproduced the U.S. by substantial ratios in most categories. The NATO-Warsaw Pact figures are somewhat closer. This again illustrates the major contribution non-U.S. partners in NATO make to the common defense as compared to the contribution of non-Soviet countries to the Warsaw Pact. Overall, Warsaw Pact industry out produced NATO industry in 11 categories, with 2 categories about even. These relative statistics, which have been about the same for the past 15 years, underscore the importance of our maintaining technological superiority to offset the larger production and the larger number of deployed weapons in the Pact forces. At the same time it reminds us that our forces face problems in those situations in which technology and quality do not offset numbers.

## Export Control

For nearly two decades, the Soviet Union has maintained a national-level program for acquiring critical military-related Western technology. This effort is large. It is well organized and it is effective. Fearful of the technological superiority of the West, Soviet military decision-makers have mandated the acquisition of such technology through a variety of mechanisms. The Soviets use intelligence organizations;

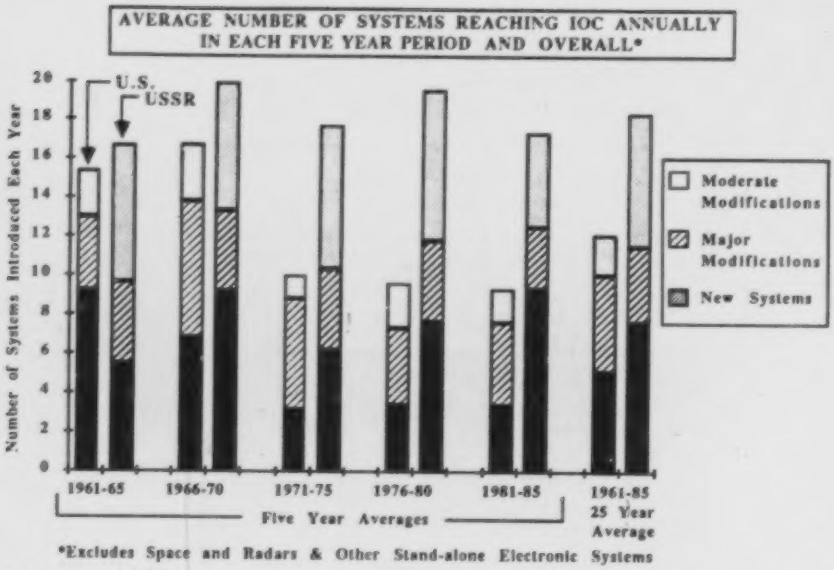


Figure II-4. Average Number of U.S. and USSR New and Modified Weapons Systems Reaching IOC Annually, 1961-1985

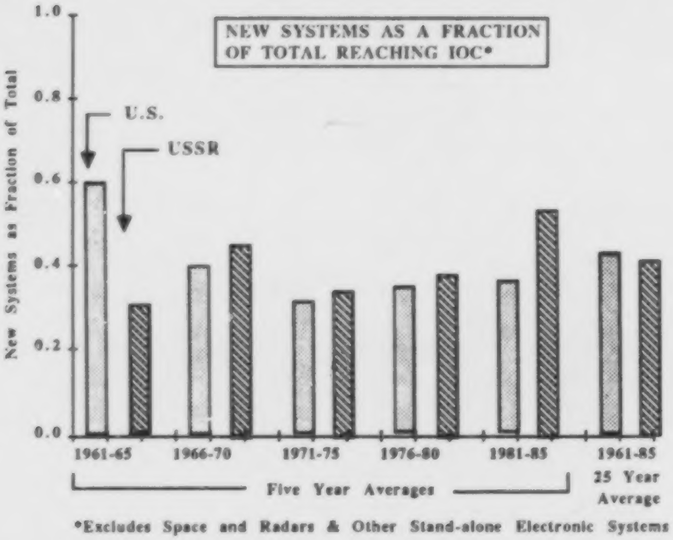


Figure II-5. U.S. and USSR New Weapon Systems as a Fraction of Total New and Modified Systems Introduced, 1961-1985

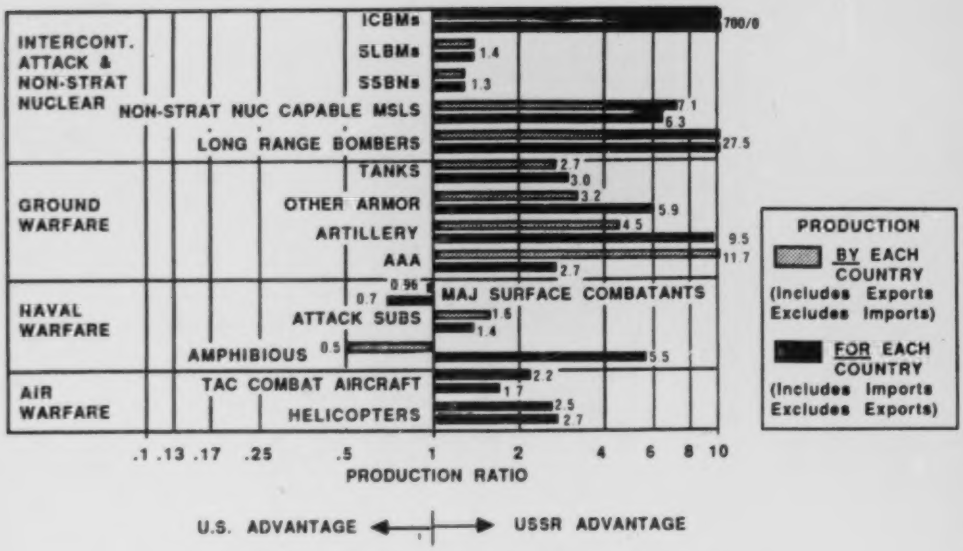


Figure II-6. Production Ratios of Selected Weapons: U.S. and USSR, 1981-1985

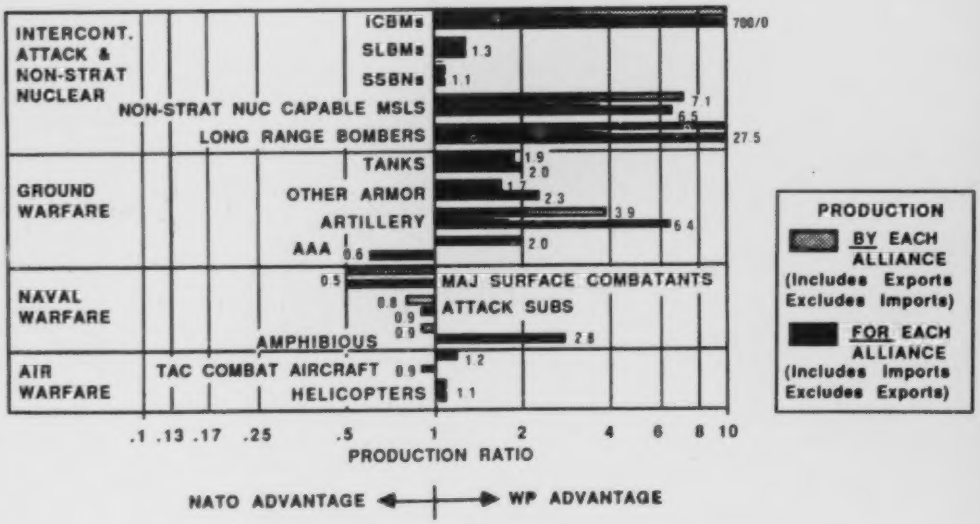


Figure II-7. Production Ratios of Selected Weapons: NATO and Warsaw Pact, 1981-1985

KGB (Committee for State Security) and GRU (Chief Intelligence Directorate of the General Staff); the facilities of the Ministry of Foreign Trade in Western countries, including state owned business corporations; the State Committee on Science and Technology, which arranges government science and technology agreements; and the Academies of Science and their Institutes, which have contacts with Western universities and research institutes both directly and through technical conferences. These Soviet organizations also have the cooperation of their counterparts in other Soviet Bloc countries.

We have long argued the significant negative effects on the military balance of successful acquisition of Western goods and technology by the Warsaw Pact. This contribution to Warsaw Pact military efforts has:

- Saved billions of rubles;
- Reduced weapon systems procurement times;
- Enhanced the productivity of the defense industrial base;
- Reduced engineering risks in weapons development; and
- Enabled more effective responses to Western weapons and tactics.

The operational military impact of these technology acquisition efforts is particularly disturbing. Table II-5 enumerates a number of Soviet/Warsaw Pact acquisitions over the last 30 years that have provided important contributions to Soviet capabilities in key mission areas.

We see several important ways in which acquired technology has impacted on Soviet military capability:

- There is evidence that such technology has directly contributed to Soviet weapons systems (e.g., through reverse engineering or through direct use of products or expertise employed in weapon development programs). The contribution of Western microelectronics is a clear example of this type of effect.
- Similarly, we have seen significant improvements in Soviet industrial productivity which have occurred through the use of acquired products and technology (e.g., robotics).

## Table II-5. Examples of Western Technological Contributions to Soviet Military Capability

| Western Technology Acquired → | Soviet Application/Improvement |
|---|---|
| **Strategic Missiles** | |
| Documents on Cruise Missiles Using Radar Terrain Maps | Cruise Missile Guidance |
| Documents on Heat Shielding Material for Reentry Vehicles | Ballistic Missile Warheads |
| Documents on Ballistic Missile Defense Concepts | Future Ballistic Missile Defense |
| **Ground Warfare** | |
| International Radar Conference Documents | Synthetic Aperture Radar for Aircraft Detection |
| Ground Support Equipments for U.S. TOW Antitank Guided Missile | Countermeasure System |
| U.S. Copperhead Laser-Guided Artillery Documents | New Laser-Guided Artillery Shell |
| Laser-Guided Missile Documents | Portable Antiaircraft System |
| Infrared Imaging Subsystem Designs | Fire-Control System of Future Tank |
| Millimeter Radar Documents | Antitank Missile |
| Pressure Measuring Instruments and Documents | Advanced Modeling for New Artillery Projectiles |
| **Naval Warfare** | |
| Aircraft Carrier Steam Catapult Design Documents | Aircraft Launching System for New Aircraft Carrier |
| U.S. MK 48 Torpedo Documents | Antisubmarine Torpedo |
| Gamma Radiation Radiometer | Nuclear Submarine Wake-Detection Trailing System |
| Acoustic Spectrum Analyzer | Submarine Quieting |
| Powerful Acoustical Vibrator | Submarine and Ship Sonars |
| **Air Warfare** | |
| F-14, F-15, F-18 Documents on Fire-Control Radars | Four Soviet Fighter Aircraft |
| U.S. Phoenix Missile Documents | Semiactive Air-to-Air Missile |
| Infrared Radiometer | Reduced Infrared Signature Aircraft |
| Fiber-Optics System | Aircraft and Missile Onboard Communication Systems |
| Air-to-Air Missile Documents | New Air-to-Air Missile |
| **Space and Antisatellite Weapons** | |
| Documents on Systems and Heat Shield of the U.S. Space Shuttle | Reusable Space System |
| Transit Naval Navigation Hardware | First-Generation Space-Based Naval Radio Navigation System |
| U.S. Navstar Navigation System Document | Digital Signal Processing for Counterpart Satellite System |
| High-Energy Chemical Laser Documents | Space-Based Laser Weapon |
| System 101 Processing Equipment | Digital Processing and Video for Space Based Reconnaissance; Missile, Bomb and Remotely Piloted Vehicle Command Guidance |
| **Manufacturing and Technology** | |
| Kevlar 49 Fiber Documents for Missiles | Improved Missile Development |
| Complete Set of Manufacturing Equipment for Printed Circuit Boards | Copied for 11 Production Assembly Lines for Strategic Missile, Armor and Electro-Optics, and Radar Industries |
| DTS-70 Printed Circuit Board Testing System | Military Microelectronic Production System |
| Fiberglass Manufacturing Technology | High-Pressure Air Tanks for Submarines |
| Computer Disk Memory System | Military Ryad Series Disk Drives |
| Bubble Memory Technology | Tactical Missile Onboard Memories |
| Technical Documents on Tests of Cold-Rolled Steel | Improved Structural Protection of Warships |
| High-Accuracy Three-Dimension Coordinate Measuring Machine | Copied for Several Industries |

- Finally, our studies show significant savings in Soviet defense resources which have occurred through the exploitation of Western technology which we believe has been applied to other aspects of Soviet defense. Our estimates of such savings to their defense budget approach tens of billions of rubles. These savings have very high military leverage, particularly in their quest for qualitative weapons improvements.

As the Soviets pursue their aggressive technology acquisition program, the U.S. and its allies must continue to work diligently to curtail those transfers that could have significant adverse military impact. Our recent export control efforts have been successful in curtailing some critical transfers; indeed our studies have shown that, since the early 1980's, the U.S. Technology Security Program has denied the Soviets information and material they would have otherwise obtained. There will be continued efforts on the part of the Soviets to acquire specific technologies in the coming years. Given this fact, we must continue to place emphasis on restricting transfers, not only through the use of the domestic Commodity Control List (CCL) and the International Coordinating Committee (COCOM), but also through other channels. Bilateral arrangements are in process or have been worked out with certain non-COCOM countries regarding protection of U.S. militarily critical technologies and products. Success in these efforts may well be one of the more urgent defense issues for the coming years.

## CONCLUSION

We have presented our view of the U.S.-USSR R&D and to a lesser extent the NATO-Warsaw Pact balance. The USSR has been investing heavily and is indeed deriving benefits from U.S. and allied programs. It has been introducing new weapons and modifications at a much faster pace than the U.S. Its centralized system allows it to pursue goals with a singular focus that we have been able to generate only in limited instances. At the same time, our free enterprise system gives us a flexibility that has allowed us to keep ahead in technology.

# III. STRATEGIC AND NON-STRATEGIC NUCLEAR PROGRAMS

## INTRODUCTION

The forces discussed in this chapter include the strategic triad, non-strategic nuclear forces, and strategic defensive systems.

Our basic strategy is deterrence across the entire spectrum of conflict. The balance of American military deterrent power is our strategic nuclear arsenal: intercontinental bombers and associated tankers; land based Intercontinental Ballistic Missiles (ICBMs); and Submarine-Launched Ballistic Missiles (SLBMs) and the Nuclear Submarines (SSBNs) that launch them.

Deterrence is a function of three factors: military capabilities, the will to use them, and a potential aggressor's perception of the first two. Thus, implicit in our concept of deterrence is the capability and determination, should deterrence fail, to deny the enemy, particularly the Soviets, their objectives at any level of conflict.

Throughout the 1960's we possessed a strong deterrent. Our nuclear posture confronted the Soviet leadership with a retaliatory capability sufficient to deny any aggressive ambition it may have harbored. During the 1970's, the U.S. attempted to promote and maintain nuclear stability through negotiation and unilateral restraint with regard to our own strategic forces. Unfortunately, by the 1980's it became apparent that Soviet efforts were not aimed at achieving nuclear stability, but at denying us a retaliatory capability.

This evolution is dramatically illustrated in Figure III-1 and Table III-1, which depict the major offensive improvements made by the Soviets and the U.S. since the 1960's and 1970's. The USSR has introduced 10 new weapons and 17 weapon modifications over the last 10 years, compared to 4 new weapons and only 5 modifications for the U.S. The USSR has been most active in upgrading its ICBM force, the most destabilizing of the offensive forces introducing at least seven modifications during the period. More importantly, over the past ten years, Soviet production of strategic weapons far

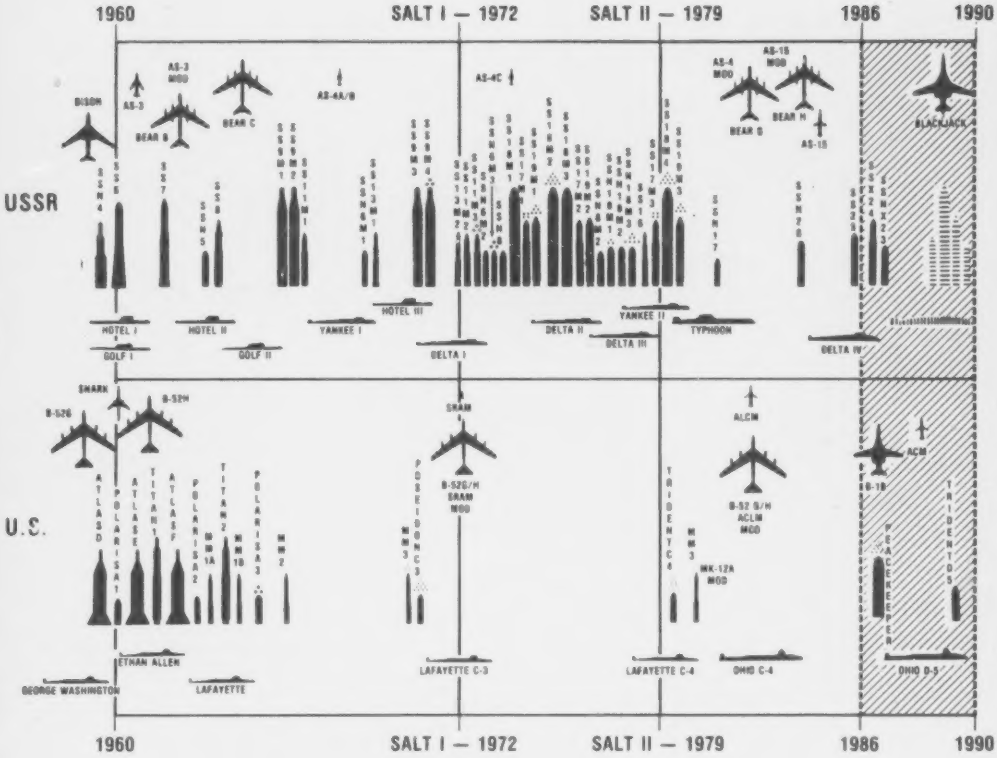


Figure III-1. New and Improved U.S. and USSR Intercontinental Attack Systems by IOC Date, 1960-1990

exceeds that of the U.S. in both types and numbers (Table III-2).

Another measure of comparison is the estimated inventory value (defined in this case as the original procurement cost of the force measured in 1987 dollars) of the three strategic force components of the U.S. and USSR (Figures III-2 and III-3). During the past 20 years, the USSR has by this measure substantially increased its emphasis on strategic submarine forces, while the U.S. has maintained a relatively constant balance among force components over the period.

By the early 1980's, we were confronted by a serious deterioration in U.S. strategic nuclear capabilities. This was due not only to the Soviet offensive force improvements discussed

## Table III-1. Number of U.S. and USSR Strategic Warfare and Non-Strategic Nuclear Weapons Reaching IOC, 1976-1985

| Weapon Type | New | | Major Modifications | | Moderate Modifications | | Total 1976-1985 | |
|---|---|---|---|---|---|---|---|---|
| | U.S. | USSR | U.S. | USSR | U.S | USSR | U.S. | USSR |
| ICBM | 0 | 2 | 1 | 2 | 0 | 5 | 1 | 9 |
| SLBMs | 1 | 3 | 0 | 0 | 0 | 3 | 1 | 6 |
| Intercontinental Attack Bombers | 0 | 0 | 0 | 2 | 1 | 0 | 1 | 2 |
| SSBs and SSBNs | 1 | 1 | 1 | 4 | 0 | 0 | 2 | 5 |
| Strategic ASMs | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| Non-Strategic Nuclear Weapons | 1 | 3 | 2 | 0 | 0 | 1 | 3 | 4 |
| Total | 4 | 10 | 4 | 8 | 1 | 9 | 9 | 27 |

## Table III-2. Production Summary of Intercontinental Attack Weapons for U.S. and USSR, 1976-1985*

| Category | 1976-1985 10-Year Total | | 1985 | | 10-Year Trend | |
|---|---|---|---|---|---|---|
| | U.S. | USSR | U.S. | USSR | U.S. | USSR |
| ICBMs | 135 | 2000 | 0 | 100 | ↓ | ↓ |
| SLBMs | 567 | 1350 | 74 | 100 | — | — |
| SSBNs | 6 | 25 | 1 | 2 | — | — |
| Intercontinental Bombers** | 2 | 55 | 2 | 20 | ↑ | ↑ |

* Does not include production for R&D.

** Does not include Backfire production.

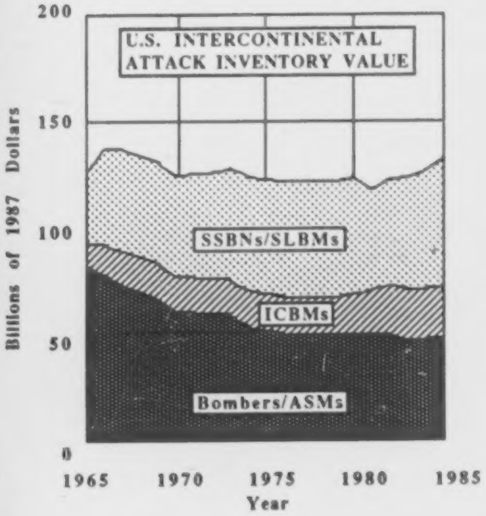


Figure III-2. U.S. Inventory Value of Intercontinental Attack Forces by Triad Component, 1965-1985

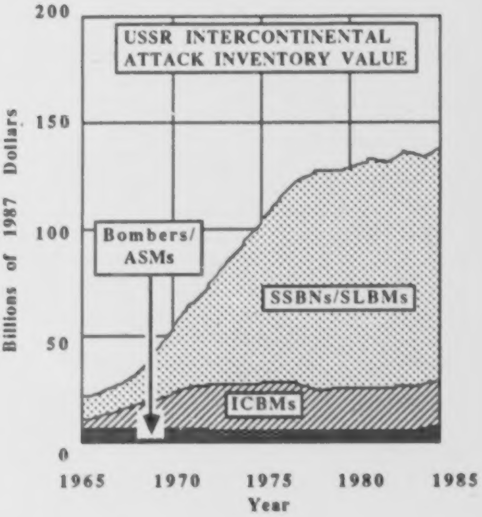


Figure III-3. USSR Inventory Value of Intercontinental Attack Forces by Triad Component, 1965-1985

previously, but also to improvements in their defensive capabilities. Soviet air defenses had become sufficiently sophisticated to jeopardize severely the ability of our B-52s to penetrate. In addition, continuing survivability improvements of their leadership and command and control systems were eroding our capabilities to hold these strategic assets at risk.

Our response has been to take vigorous steps to reverse this imbalance through President Reagan's Strategic Modernization Program. Under this broad initiative, we are working to modernize all three legs of our strategic offensive forces (Table III-3). Our ICBM forces are being upgraded now with the new Peacekeeper missile; and later, the Small ICBM, which is currently in the early phase of development. We will continue to add new Trident submarines to the undersea fleet armed with the C-4 and eventually the D-5 SLBM. The new B-1B bomber is in production, and the Advanced Technology Bomber (ATB) is progressing well in development. Additionally, the B-52 fleet is now equipped with over 1500 ALCMs, and we are deploying other cruise missiles for use on submarines and ships.

These efforts to modernize U.S. forces should go a long way toward restoring the balance between U.S. and

## Table III-3. U.S./USSR Strategic Offensive Modernization Programs

| U.S. | | USSR | |
|---|---|---|---|
| **System** | **Qualitative Trends** | **System** | **Qualitative Trends** |
| **ICBMs** | | | |
| Peacekeeper | • Accuracy and throwweight for increased hard target capability and target coverage | SS-X-24 (Peacekeeper class) | • Mobility (and solid propellants) for survivability |
| Small ICBM | • Mobility and/or superhardening for survivability | SS-25 (Minuteman class) | • Mobility for survivability |
| PENAIDS | • Decoys and/or MaRVs for high confidence penetrativity | SS-18 Follow Ons | • Accuracy and throwweight for increased hard target capability |
| **Ballistic Missile Submarines and SLBMs** | | | |
| Ohio class Trident SSBN | • Quieting and performance for high survivability<br>• Sized for increased firepower | Typhoon SSBN | • Quieting and operation under polar icecap for survivability |
| Trident II (D-5) SLBM | • Accuracy and throwweight for increased target flexibility and target coverage | SS-N-20 SLBM,<br>SS-NX-23 SLBM | • Accuracy and throwweight for increased target coverage |
| **Bombers and Air-to-Surface Missiles** | | | |
| B-1B (with cruise missile capability) | • Base escape speed and hardness for improved launch survivability<br>• High speed, low altitude and low RCS, plus ECM for improved penetration survivability | Blackjack Bomber (with cruise missile capability) | • Long range and high payload for target coverage and firepower |
| B-52/Air Launched Cruise Missile | • Force multiplier<br>• High accuracy, long range and low RCS for penetration survivability | Bear H/AS-15 Air Launched Cruise Missile | • Force multiplier and standoff launch with Low RCS missiles for survivability, reuse |
| Advanced Cruise Missile | • Low observables for enhanced penetration capability | | |
| Short Range Attack Missile (SRAM II) | • Small, high speed for increased carriage and enhanced penetration capability | | |

Soviet offensive forces. At the same time, however, the USSR is pursuing a vigorous program of modernization that threatens to outstrip us if we do not continue to execute our current plans and fully deploy the systems now in development.

In strategic defense there is a larger disparity between U.S. and Soviet force modernization efforts (Table III-4). The USSR is deploying new ground radars, an upgraded Moscow anti-ballistic missile system, surface-to-air

## Table III-4. U.S./USSR Strategic Defensive Modernization Programs

| U.S. | | USSR | |
|---|---|---|---|
| **System** | **Qualitative Trends** | **System** | **Qualitative Trends** |
| **Radars** | | | |
| Ballistic Missile Early Warning System (BMEWS) | • Improved early warning | Krasnoyarsk and Pushkino Very Large Battle Management Radars | • Improved potential for nationwide ABM capability |
| PAVE PAWS Ballistic Missile Warning System | • Continental coverage for warning of SLBM attack | IL-76 (Mainstay) AWACS | • Improved capability to detect and identify low altitude aircraft and cruise missiles |
| Over-the-Horizon Radar (OTH-B) | • Long Range, all-altitude surveillance<br>• Flexible capability to address future threats | | |
| **Surface-to-Air Systems** | | | |
| None | | Modified Galosh ABM High Acceleration Missile | • Two-layer ABM defense |
| | | SA-10 (SAM) System Modification | • Mobility for increased survivability |
| | | SA-X-12 Gladiator SAM System * | • Deployable supplemental ABM capability<br>• Improved low altitude capability |
| **Anti-Satellite Systems** | | | |
| F-15/Anti-Satellite System | • Responsive to low altitude Soviet satellite<br>• Launch flexibility | Ground-Based Lasers<br>Advanced ASATs | • Complements deployed co-orbital system and Galosh ABM Interceptor<br>• Associated with BMD work |
| **Air-to-Air Systems** | | | |
| F-15** | • Improved air-to-air capability | MiG-31 (Foxhound)** | • Improved capability to engage low altitude aircraft and cruise missiles |
| F-16** | • Same as above | | |
| AMRAAM** | • Multiple engagements against ECM<br>• Improved speed, agility and warhead | Air-to-Air Missile, AA-9** | • Provides look down/shoot down capability |

* Also included in Ground Warfare modernization comparison in Chapter IV.

** Also included in Air Warfare modernization comparison in Chapter IV.

missile systems and air-to-air systems. In addition, the Soviets are developing and deploying airborne warning and control systems which will further challenge the capability of our bombers to penetrate. In contrast, the U.S. has to this point modernized only its warning systems, begun modernization of its small force of dedicated air defense interceptors, and pursued initial development of the U.S. ASAT system. This situation may change, however, with the Strategic Defense Initiative (SDI). The SDI research program offers the possibility of a more stable deterrence based upon defenses that are survivable, militarily effective, and reasonable in cost. If our vigorous research shows that such defenses against ballistic missiles are feasible, then we may transition from a deterrence based largely on the threat of nuclear retaliation to one based upon defensive capabilities that poses no threat to anyone. SDI research programs also provide insurance against the unilateral Soviet deployment of a similar system, as well as a necessary response to the current Soviet offensive and defensive buildup.

In non-strategic nuclear systems, the USSR is also pursuing a vigorous program with the development of theater ballistic and cruise missile systems (Table III-5). The U.S. is countering these systems with the deployment of the Pershing II and Ground Launched Cruise Missile (GLCM), which together provide many of the force characteristics needed to offset Soviet force improvements.

The challenge to us is to complete these programs within the constraint of a strategic forces budget that has been held to less than 15% of the overall DoD budget for the past 20 years (Figure III-4). This is being accomplished by exploiting the technological advantages we have over the Soviets. For example, in the ICBM area, we can put their hard

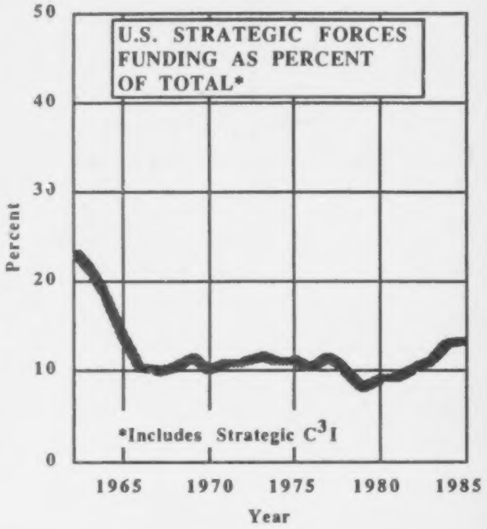


Figure III-4. Strategic Forces Funding as a Percent of Total DoD Funding, 1962-1985

Table III-5. U.S./USSR Non-Strategic Nuclear Modernization Programs

| U.S. | | USSR | |
|---|---|---|---|
| **System** | **Qualitative Trends** | **System** | **Qualitative Trends** |
| **Ballistic Missiles** | | | |
| Pershing II | • Rapid response for time-urgent targets<br>• High mission flexibility and survivability<br>• High accuracy permitting reduced warhead yields and lower collateral damage | Improved SS-20 | • Improved accuracy |
| **Ground Launched Cruise Missiles** | | | |
| Ground Launched Cruise Missile (GLCM) | • Increased theater firepower<br>• Increased survivability of theater nuclear force<br>• Low altitude, low radar cross section, and small infrared signature | SS-CX-4 (GLCM)<br>New Large GLCM Development | • New peripheral attack capabilities; eventual accuracy improvements for non-nuclear applications |
| **Sea Launched Cruise Missiles** | | | |
| Sea Launched Cruise Missile (SLCM) | • Long range, high accuracy and low RCS for launch and penetration survivability<br>• Ship platform flexibility | SS-NX-24 (Large SLCM)<br>SS-NX-21 (Small SLCM) | • Increased firepower and force multiplier<br>• Standoff capability to attack with reduced warning |
| **Artillery** | | | |
| W79 8-inch Artillery Fired Atom Projectile (AFAP)<br>W82 155mm AFAP | • Improved safety, security, range and survivability over current projectiles | 152 mm nuclear capable, self-propelled and towed | • Improved range<br>• Higher initial rate of fire |

targets at risk by our capability to achieve very good accuracy. This offsets the Soviet advantage in throwweight. Further, the potential of the SDI to make ballistic missiles obsolete in the far term may work to help maintain the strategic balance. In the bomber area, our progress in low observable technology for both bombers and cruise missiles will offset the formidable air defense capability of the Soviets and provide insurance against a significant Soviet breakthrough in ballistic missile defense.

Cruise and standoff air-to-surface missiles are also good examples of capabilities derived from our advanced technology. Developments in propulsion, guidance, and miniaturization of components have enabled us to develop systems which offer a significant force multiplier effect, as well as improved flexibility and high survivability. For example, we are developing and deploying sea-launched cruise missile variants capable of both nuclear and conventional attack, which can be launched from submarines, battleships, cruisers, and destroyers. There are similar high leverage technologies in other areas as well. The key point is simply this: our strategy must be to exploit technology for the leverage benefits it provides over Soviet advantages in strategic force mass and capability.

## STRATEGIC PROGRAMS GOALS/OBJECTIVES

The primary objective of U.S. strategic forces remains the maintenance of stable deterrence. Our strategic forces must be able to survive a well-executed surprise attack and be capable of retaliating against a wide range of possible targets while retaining a secure reserve force as a further deterrent. The Soviet Union is challenging our basic objective by gaining advantages in critical nuclear force capabilities, thereby threatening our deterrent strategy. To counter the Soviet's growing nuclear warfighting potential, the President has given the highest priority to the modernization of our strategic nuclear forces. In addition, equitable and verifiable arms reduction agreements are being pursued in parallel with these modernization programs. The objective of these efforts is to create a more stable nuclear balance at reduced levels of armament.

U.S. nuclear forces include strategic weapons deployed on land (ICBMs), at sea (SLBMs), and in the air (heavy bombers). These three major force elements comprise the well-known strategic triad. The distribution strategic forces within the triad is a key factor in assessing the deterrent capabilities of our forces compared to the Soviets. Unlike the United States, the Soviets rely on numerous heavy ICBMs which pose the greatest threat to military and civilian targets in our country. Our nuclear forces, in contrast, are more evenly distributed, with the bulk of our nuclear weapons deployed on less powerful and less accurate SLBMs or relatively slow-flying bombers. Thus, U.S. forces are designed only for retaliation, and they lack the needed yield, accuracy and promptness to threaten the Soviets with a credible first strike attack.

Each element of the strategic triad offers differing characteristics in terms of responsiveness, accuracy, control, targeting flexibility, and destructive power. These unique characteristics provide a hedge against a Soviet breakthrough in technology or a breakout from an arms control agreement that might jeopardize the capability of one or more of the other elements. Also, the depth and redundancy of our forces bolster the credibility and effectiveness of our nuclear deterrent and provide us with a range of retaliatory options short of a spasmodic, suicidal response to a Soviet attack. These qualities force the Soviets to account for a multiplicity of threats by developing extensive defensive capabilities against each element.

In the paragraphs that follow, we will outline the objective of each triad element, assess its capability, and report the progress we have made in upgrading it to meet the increasing demands of a credible deterrent posture.

## INTERCONTINENTAL OFFENSIVE FORCES

### Introduction

In their move toward strategic superiority, Soviet strategic forces continue to grow and improve. The number of strategic nuclear warheads targeted against us has doubled since the SALT II treaty was signed in 1979. In fact, the era of SALT II was a time for rapid buildup of Soviet forces as shown in Figure III-1. Currently, the Soviets have a four to one advantage over us in deployed ICBM throwweight--a useful static measure of force capability. Also, their move to mobile ICBMs continues unabated, with the road mobile SS-25 now operational and the rail mobile SS-X-24 under development.

As regards SSBNs and SLBMs, the Soviets continue their rapid expansion with two classes of ballistic missile submarines, the DELTA IV and TYPHOON. They have been producing an average of 130 SLBMs annually for the past ten years with a strong trend toward longer range and greater accuracy. This gives the Soviets the capability to launch SLBMs against us from waters close to their home ports under the protection of their anti-submarine warfare capabilities and land-based air cover. Thus, this strategy reduces their requirements for "on station" patrols that are more difficult to sustain and defend.

In bombers, the Soviets are producing new BEAR-H cruise-missile-carrying bombers and nearing initial deployment of the BLACKJACK. Contrary to popular belief, the Soviets enjoy an advantage in numbers of cruise missiles, with five new types of air-, sea-, and ground-launched cruise missiles either deployed or in development.

The next paragraphs describe our efforts to reverse these trends.

## Land-Based ICBM Forces

The need to modernize our ICBM forces for the tasks of the 1980's, 1990's and beyond still requires near and far term solutions. In the near term, the Peacekeeper ICBM is needed to redress the growing asymmetry between the hardening of Soviet high priority assets and our ability to place these assets at prompt risk. We are now proceeding with a two-phase modernization program involving the silo-based ICBM force with the deployment of 50 missiles in Minuteman silos, and continued research on alternate basing modes, all directed toward a force of 100 deployed missiles. The Peacekeeper flight test program continues on schedule with ten successful test flights to date, the last two from a modified Minuteman test silo at Vandenberg AFB. We are proceeding with our evaluations of more survivable basing modes, including superhard silos, deceptive concepts also incorporating new hardening technology, and the so-called "shallow tunnel" and "carry hard" modes. Recent advances allow us to achieve silo hardness levels far in excess of those ever thought possible. Our work now is focused on reducing costs for these silos. Superhard silo basing would counter the current Soviet threat and help in the transition to longer term solutions involving mobility, deception and/or active defense. The advanced deceptive systems for Peacekeeper are less well developed than superhard silos, but they, too, appear promising.

To enhance strategic stability in the 1990's, the small ICBM program provides for increased survivability due to its adaptability to various basing modes. The superhard silo, hard mobile launchers on DoD land, and hard mobile launcher on Minuteman launch facilities all continue to show promise, and development programs are progressing on schedule. With a planned nine-year development cycle, this program will challenge our capabilities, and we are proceeding with a demanding development schedule to overcome the major technical challenges of low missile weight, lightweight/

accurate/responsive guidance systems, and system mobility and survivability. The development focus is on providing a militarily effective missile and basing combination which would be survivable well into the next century.

The Soviets are upgrading the Moscow ABM system and developing a dual air defense system, the SA-X-12, whose variants are designed to have both an anti-tactical ballistic missile and anti-aircraft capability. To ensure the continued penetration capability of our ICBMs and SLBMs, we have a vigorous effort under the Advanced Strategic Missile System (ASMS) program to develop suitable penetration aids (PENAIDS). In our principal effort, we are beginning development of a PENAID system for the Minuteman III. Test flights of the components so far have been successful, and we are confident it will meet the near-term threat posed by Soviet ABM capabilities.

Soviet efforts toward surviving a nuclear exchange through mobility, hardening, and deep underground emplacement of key warfighting assets make the U.S. strategic targeting problem increasingly difficult. To maintain an effective deterrent posture, U.S. forces must offer the capability to locate, evaluate, target, and strike strategic Soviet targets rapidly. Several projects address this problem, such as the proof-of-principle demonstration of rapid retargeting of Minuteman III, and the development of rapid retargeting of a single warhead Minuteman II. These programs offer the potential for an improved and flexible capability to hold at risk various categories of Soviet strategic relocatable targets.

## Sea-Based Forces

The U.S. SSBN/SLBM force possesses the highest survivability of any element of the triad. The security of extended operations at sea provides a high degree of deterrence because the Soviets cannot place the SSBN/SLBM force at sea at risk of a first strike attack. This high degree of survivability makes these weapon systems an important element of our deterrent posture.

Our work in modernizing this element of the triad is proceeding on schedule, with the seventh OHIO-class SSBN-732, the USS Alaska, entering sea trials in September 1985. The sixth TRIDENT submarine, the USS Alabama (SSBN-731), was commissioned and accepted by the Navy in May 1985. We are confident the superb technology of these SSBNs will ensure a reliable SLBM deterrent well into the next century.

The engineering development of the TRIDENT II (D-5) SLBM is proceeding toward the goal of a December 1989 Initial Operational Capability (IOC). We expect the first flight test early in 1987, and an aggressive flight test program before IOC will validate the complete range of flight conditions. The IOC is planned for Kings Bay, Georgia, aboard SSBN-734. Twenty test flights are currently planned from a launch pad and ten from an SSBN.

## Bomber/Cruise Missile Forces

An effective bomber force is essential to our deterrent because its unique characteristics complement the ICBM and SLBM elements of the triad. Manned bombers have a high degree of flexibility, are adaptable to various situations, and are fully mobile. During a crisis, bombers can be launched under positive control, dispersed to satellite bases, or placed on airborne alert. Their long flight times make bombers excellent retaliatory (as opposed to first strike) weapons, and their visibility and flexibility make them effective for demonstrating political will. The U.S. bomber force will have a mix of modern bombers that can penetrate Soviet airspace carrying short range missiles and gravity bombs, with others carrying long range cruise missiles for launch outside the range of Soviet air defenses.

Our major initiatives in this area, the B-1B and the Advanced Technology Bomber, remain on schedule. We are now deploying the B-1B bomber with the IOC planned for September 1986, at Dyess AFB, Texas. Production will peak at four aircraft per month, and all 100 aircraft will be delivered by mid-1988. The program remains under the $20.5 billion cost ceiling (FY 81 $) and ahead of the contract schedule. We are completing plans to qualify the aircraft for cruise missile launch.

Details of our progress and schedule for the ATB program remain classified; however, we are highly pleased with the development program to date and no major problems have emerged to slow our work. The program is proceeding smoothly toward the first ATB test flight and a production decision. The low observable technologies involved in the ATB program represent significant advances in our efforts to overcome increasingly capable Soviet defenses and will extend the effectiveness of the penetrating bomber element of the triad well into the next century.

Another important initiative in this area is the new Short Range Attack Missile (SRAM II) which provides the bomber force with an improved capability to attack defended targets and to suppress enemy defenses while remaining outside the lethal defense zone. The current SRAM-A is aging out (after 14 years of service) and does not provide sufficient bomber standoff range, routing flexibility, and lethality to offset increases in Soviet air defense capability and the changing Soviet target base. SRAM II will overcome these deficiencies and greatly add to our capability to hold Soviet strategic relocatable targets at risk. Technically, we just completed our propulsion and size selection by deciding on rocket in lieu of ramjet propulsion (because of its lower cost), and a size two-thirds that of SRAM-A (to increase bomber carriage and improve weapon survivability). After a comparative source selection, we will award a full scale development contract for SRAM II.

To ensure the continued effectiveness of our cruise missile forces, we are well into successful development of the Advanced Cruise Missile (ACM), which will be deployed later in the decade. The additional range, higher survivability (because of reduced radar observables), and increased accuracy of this weapon will all work to further enhance the capabilities of our bomber force. In conjunction with the currently deployed ALCM, the ACM will round out our ability to cover the complete spectrum of strategic cruise missile targets.

Some capabilities within our strategic nuclear forces provide wide application for force projection missions, from a demonstration of resolve to full-scale theater warfare support. An important initiative in this area is the Strategic Conventional Standoff Capability (SCSC), which is intended to exploit the long-range, high-payload capability of the B-52 bomber and off-the-shelf sensors and conventional weapons to provide a capability for interdiction, deep strike, maritime anti-surface warfare, mine laying, etc. Two squadrons of our B-52G's are now equipped with the HARPOON anti-ship missile, and the SCSC program will greatly supplement this capability.

## STRATEGIC DEFENSIVE FORCES

The Soviets continue to increase their active and passive defenses against the broad range of conventional and nuclear weapons. Active defenses use weapon systems to protect national territory, military forces, or critical assets. Passive defenses are measures such as civil defense, hardening, dispersal, and underground basing, which are increasingly being used by the

Soviets to protect key assets against attack. These measures contribute to the Soviet's war-winning and survival strategy by providing a modernization and post-attack capability far superior to ours.

In active air defense, the Soviets have nearly 12,000 surface-to-air missile (SAM) launchers at over 1200 sites, 10,000 air defense radars, and more than 1200 interceptor aircraft dedicated to strategic defense. An additional 2800 interceptors assigned to the Soviet Air Force would also be used in strategic defense missions. In contrast, the U.S. has approximately 300 interceptor aircraft, no SAM systems, and 118 strategic air defense warning radars.

In missile defense, the Soviets maintain the world's only operational ABM system around Moscow. When completed, the modernized Moscow ABM system will be a two-layered terminal defense composed of silo-based, long-range interceptors for exoatmospheric intercepts, high-acceleration interceptors intended for targets within the atmosphere, along with a large new radar designed to control ABM engagements. The Soviets also have the world's only operational anti-satellite system.

The Soviets have had for some time a substantial research program on advanced technologies for defense against ballistic missiles. This program covers many of the same technologies involved in our Strategic Defense Initiative (SDI) program, but involves a far greater investment in people, funding, and facilities.

U.S. strategic defensive systems will reduce the potential effectiveness of Soviet nuclear attacks and add uncertainty to the possible outcomes of an attack, thus undermining Soviet confidence in success. Current U.S. strategic defenses include air defense forces and ground and space-based surveillance systems.

Our major initiative in the surveillance and warning area is the Over-the-Horizon Backscatter (OTH-B) radar system intended to provide long-range, all-altitude coverage against enemy bombers and cruise missiles. We will be deploying OTH-B sectors in the east, west, central U.S., and Alaska with IOCs stretching out through the early 1990's. When combined with the North Warning System, (which is to repalce the obsolete DEW line) OTH-B will provide the U.S. with a credible attack warning capability to increase the survivability of our strategic retaliatory forces.

In space defense, our Anti-Satellite (ASAT) program had a notable success in September 1985, when it intercepted and destroyed a satellite over the Pacific Ocean. The ASAT is comprised of the Miniature Vehicle (MV) which is air-launched from an F-15 aircraft using a SRAM/ALTAIR booster. Further tests planned this year against an Instrumented Test Vehicle (ITV) to provide detailed data on the actual intercept are under suspension by the Congress. Consistent with previous congressional authorization, on 12 December 1985, we placed into orbit two ITV's which have a limited lifetime. If the present congressional decision stands and testing is prohibited, the taxpayers will lose approximately $20 million invested in the launch of these targets. As the Secretary of Defense has stated, this congressional action could also undercut arms control and impair our national security. We hope Congress will work with us to take corrective action and promptly restore our ability to conduct these tests.

By the mid-1990's, intelligence estimates indicate the potential for a significantly increased Soviet strategic intercontinental bomber threat. Effective strategic missile defenses would still leave the U.S. exposed to attack by bombers and cruise missiles. Thus, corresponding options for effective air defenses against bombers and cruise missiles are also needed. This year, we are beginning an initiative to define the specific technologies and programs needed to gradually build a robust defense against Soviet bombers and cruise missiles.

## Strategic Defense Initiative

The SDI is a vigorous research program being conducted in compliance with the 1972 ABM treaty. It is intended to assess the potential for advanced technologies to provide effective strategic ballistic missile defenses, and to support a decision on whether to develop and deploy advanced defensive systems . As a broad research program, the SDI is based on identifying options for an effective defensive system. Thus, a broad range of different concepts, involving a wide range of technologies, is being examined. No single concept or technology has been identified as the best or most appropriate. It is clear, though, that a layered defensive system would be able to provide many opportunities to destroy attacking nuclear warheads well before they approach our territory or that of our allies.

The interim results of architecture studies conducted last year show that kinetic energy weapons hold the highest promise for near-term systems using combinations of space-based and ground based kinetic hit-to-kill type weapons. On the other hand, directed energy weapons hold high promise for interactive discrimination and countering advanced threats. An evolutionary program, therefore, that combines the most promising near-term kinetic energy kill concepts with a longer-term program designed to exploit directed energy technologies appears very promising.

An effective strategic defense system will also require robust sensors, capable of detecting and tracking threat objects and of discriminating among reentry vehicles and decoys. Studies are progressing on defining battle management/command, control and communications architectures for strategic defense. They are indicating that a decentralized approach will have many critical advantages.

## NON-STRATEGIC NUCLEAR FORCES

The increasing Soviet buildup in theater forces makes our job of developing responsive Non-Strategic Nuclear Forces (NSNF) more essential than ever. These forces are essential because they show our firm resolve to defend U.S. and allied interests across the full spectrum of possible conflicts, and deter aggression by the Soviet/Warsaw Pact forces.

The Soviets are proceeding with their steady expansion in theater forces in every major conventional category--tanks, artillery, helicopters, missiles, etc., and also in the nuclear category where more than 400 SS-20 missiles have been deployed, with each missile having three nuclear warheads, and each system having a reload capability.

While the Soviets continue their steady expansion, we, and our allies, continue to exercise considerable restraint. For example, in 1979 a decision was agreed to by the NATO allies that called for the removal of 1,000 warheads from the NATO nuclear stockpile and the deployment of a combined total of 572 ground-launched cruise missiles (GLCMs) and Pershing II ballistic missiles, beginning in 1983. The decision further stipulated withdrawal of a presently deployed nuclear weapon for each new GLCM or Pershing II deployed. In October 1983, NATO defense ministers, meeting at Montebello, Canada, also agreed to withdraw an additional 1,400 warheads from Europe over the next several years.

As a result of the 1979 and 1983 decisions, five nuclear weapons will have been withdrawn from the NATO nuclear stockpile for every GLCM or Pershing II deployed. Thus, NATO will have cut its nuclear arsenal to its lowest level in 20 years. In contrast, the Soviet buildup in intermediate-range and shorter range nuclear weapons has continued unabated.

We, along with our allies, are just now beginning to upgrade our NSNF in response to the impressive force expansion by the Soviets. For several decades, our efforts have not kept pace; however, with the deployment of Pershing II and GLCM, we are beginning to reestablish viable deterrent capabilities. The Pershing II deployment to U.S. forces in Europe was completed in 1985 with a total operational force of 108 missiles. This missile, with its range of 1800 kilometers, has replaced the shorter-range Pershing IA.

GLCM has other capabilities that complement those of the Pershing II. With its longer range of 2500 kilometers and decreased need for rapid response time, the GLCM can be based further to the rear for increased survivability. Deployment of GLCM will be completed by 1988 with 464 missiles in place.

In addition to the GLCM and Pershing II, Artillery Fired Atomic Projectiles (AFAPs) play an important role in battlefield deterrence. AFAPs have provided a vital part of NATO nuclear deterrence and warfighting capability for over 30 years by providing the means to stop advancing ground forces. However, modern AFAPs are required to offset recent Soviet increases in both their conventional and nuclear forces. A viable AFAP capability in NATO will greatly influence Soviet estimates of Warsaw Pact probabilities of successful attack and hence contribute to deterrence.

The W79 modernized 8-inch projectiles have been in production since 1981. The DoD has also developed, and Congress has approved, a plan to produce modernized W82 155mm projectiles in accordance with modernized AFAP quantity and cost ceilings established by the DoD Authorization Act of 1985. With continued support by the Congress, we can deploy this improved round on schedule.

With respect to the longer term, our goal is to ensure that modernization of our NSNF is complementary with improvements in the capabilities of our conventional forces. In both conventional and non-strategic nuclear forces, the long term trend will be toward the development of longer range systems to enable these forces to be more widely dispersed for survivability while still permitting the attack of deeper targets. Our goal is to improve our conventional forces to enhance NATO's capability to deter Soviet conventional aggression, as well as to reduce possible pressure for early NATO use of nuclear weapons. In this regard, we will continue to evaluate the suitability of replacing nuclear weapons with non-nuclear munitions, wherever feasible.

Corresponding improvements in our NSNF posture will further reinforce NATO's capability to deter Warsaw Pact conventional aggression as well as Soviet use of nuclear weapons. Toward that end, we will pursue the development of such systems as a follow-on to the current Lance, a tactical standoff air-to-surface missile, and a nuclear Surface-to-Air Missile (SAM) for maritime force defense.

Navy systems also contribute significantly to our improved non-strategic force posture. The family of TOMAHAWK cruise missiles, for example, provides a nuclear and conventional land attack and a conventional anti-ship capability from both submarines and surface ships of the fleet. This year, we began deploying conventionally armed TOMAHAWK cruise missiles aboard surface ships and submarines.

Efforts continue to improve the security and survivability of nuclear weapons, with emphasis on the European Theater where the threat is growing. For example, we are developing a program to establish more extensive concepts, procedures, doctrine, training, hardware, and facilities to assure the survivability of NSNF. A long-range look into future threats and survivability improvements required in the next century will be conducted. The NATO Senior Level Weapons Protection Group has adopted a long-range planning document which contains not only policy guidance, but also recommended security and survivability measures, some of which have already been endorsed by NATO Ministers. This posture guidance document will provide needed direction for NATO programs well into the future.

## NUCLEAR WEAPONS

### Goal

The goal of the nuclear weapons program is to provide and maintain a safe, secure, survivable, and effective nuclear weapons stockpile in support of U.S. national security objectives. Several initiatives are being pursued in support of this goal. We are continuing the design and production of nuclear weapons to support our strategic modernization initiatives and to replace obsolete weapons with new designs which are inherently more effective, safe, secure, and survivable. We will retrofit selected stockpiled weapons with current technology to improve overall safety and command and control. We will not attempt to match the Soviets weapon for weapon (see Figures III-5 and III-6), but will continue our focus on quality across the full range of deterrent nuclear forces.

We are working with the Department of Energy (DoE) to strengthen our nuclear weapons technology base. We are also developing long-range plans that will allow us to meet future defense needs. These plans consider the constraints of limited resources or potential requirement changes that could result from either a major nuclear threat increase, technological surprise, a new arms control agreement, or a change in national strategy.

## Major Achievements

One of the major achievements of the past year is the continuation of the nuclear weapons modernization program in cooperation with the DoE. As mentioned earlier, the GLCM and Pershing II nuclear weapon systems

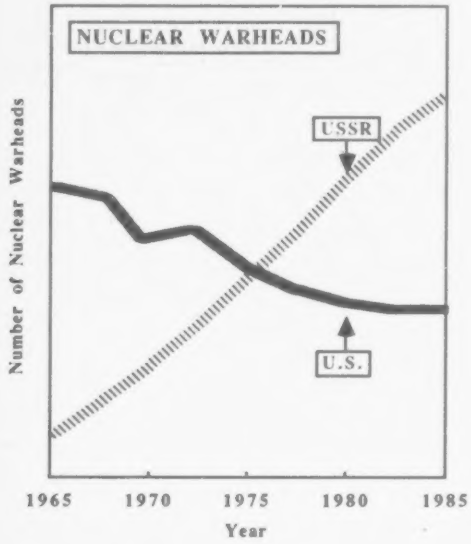


**Figure III-5. U.S. and USSR Nuclear Warheads, 1965-1985**

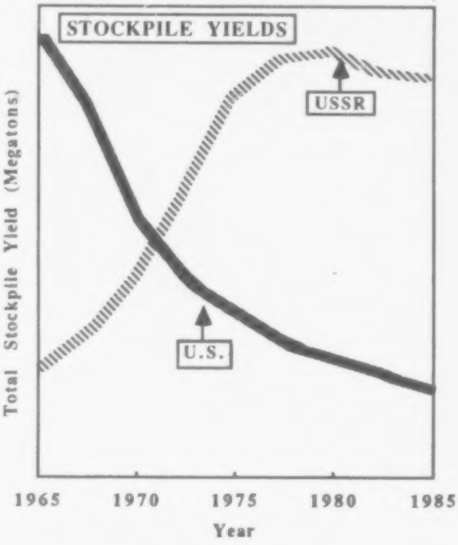


**Figure III-6. U.S. and USSR Total Stockpile Yields, 1965-1985**

deployments are examples of this modernization program.

The biennial Nuclear Weapons Development Guidance (NWDG), which provides DoD guidance to the DoE for long-range R&D planning, was completed and presented to the DoE. While addressing the nuclear requirements for the 1990's, special emphasis was placed on improving the accuracy of our forecasts and in extending the technology projections 10 to 20 years into the future.

## Technology Efforts

Efforts continue at both the DoE and the DNA to assess the survivability of military systems in nuclear environments, especially in light of more accurate Soviet missiles; to develop technology to enhance the survivability and security of U.S. forces; and to provide new technology for the intelligence community to predict destruction thresholds of enemy systems. Programs underway to upgrade the technology include underground nuclear and above ground high explosives testing, nuclear effects simulators, computer codes, exo-atmospheric experiments, and the analysis of U.S. nuclear capabilities, including advanced concept directed-energy vulnerability assessments. A research program for assessing the climatic effects of nuclear war will continue.

The underground nuclear test MISSION CYBER, in support of the Navy Trident II, and MISTY ECHO, a cratering and ground shock event, will provide an assessment of the vulnerability of strategic structures to nuclear attack, ensure optimum targeting of warheads, and provide timely data to support the evaluation of alternative Peacekeeper basing modes.

## Current Objectives

In response to recommendations made in the Report of the President's Blue Ribbon Task Group (BRTG) on Nuclear Weapons Program Mangement, completed and delivered to the President and to Congress in July 1985, we are working closely with DoE to ensure that fiscal discipline continues to receive high priority in our weapons development. For example, we have proposed new arrangements for joint DoD/DoE senior level management reviews of nuclear weapons programs and budgets, with new opportunity for tradeoffs between departments related to nuclear weapons and other defense programs. Also, we are continuing to emphasize cost factors during the development of new nuclear systems through formal interdepartmental agreements on cost baselines and more thorough management reviews of the cost characteristics of each system.

It is essential that we define the character of the future stockpile in view of improved weapon systems capabilities and changing requirements. We must also continue to improve upon the survivability and endurance of our forces and support infrastructure--both in CONUS and abroad. In addition, we plan to determine the feasibility and suitability of applying nuclear directed-energy technology to specific weapons applications. Finally, the modernization of the capital plant and infrastructure for nuclear weapons and weapons materials research, development and production must continue. In future years we must more fully consider total weapon system cost and performance in establishing military requirements and design objectives for nuclear weapons.

## Challenges and Opportunities

Within the nuclear weapons area, the greatest challenge continues to be our country's will to stay the course in modernizing our stockpile. We are faced with a formidable adversary who possesses steadily increasing capabilities, yet is rarely subject to changing military strategy or wide variations in funding. The Soviets are not content to maintain parity, but are dedicated to obtaining and maintaining clear military superiority. In response, we must sustain the effectiveness of our deterrent posture over time. We have a program for modernizing our nuclear forces and we now need the continuing commitment to bring that program to fruition in the years ahead.

It is also important to continue pursuing arms control and arms limitations agreements with the Soviets--agreements that provide for mutually verifiable limits. Until such agreements are realized, however, we must maintain a vigorous and technologically advanced program of research, development, and testing as the surest way of guaranteeing deterrence and encouraging meaningful arms control negotiations.

## LOOKING TO THE FUTURE

There is no more urgent task facing Americans than to restore and then maintain the strategic balance. Matching the Soviets system by system, number by number, is not the answer. We must exploit our innate advantages in technology that are fostered and nurtured by our free society to provide the leverage required to maintain the balance, yet stay on a reasonable economic course for the country. The Strategic Modernization Program and the Strategic Defensive Initiative are central to this effort. The high technology efforts within these programs, such as low observable technology and directed energy concepts, provide the leverage to maintain our deterrent posture. As these critical programs continue to unfold we can face the future confident of our ability to preserve peace with freedom.

# IV. TACTICAL WARFARE PROGRAMS

## INTRODUCTION

The primary objective of our Tactical Warfare Programs is to provide a credible conventional deterrent for our forces worldwide. Our primary areas of concern are Central Europe, Korea, and Southwest Asia; but we must have the capability to respond to contingencies in other areas as well. Ongoing tactical warfare programs are aimed at modernizing our weapons systems and filling munitions inventory objectives for a wide range of general purpose land, air, and naval forces. In all of these areas, we are attempting to apply emerging technologies selectively to create new, high leverage capabilities at affordable costs in order to take advantage of our basically defensive posture. These high-leverage capabilities emphasize low observables and smart weapon technologies that will render large portions of the threat obsolete. One of the major thrusts in tactical warfare is the "Conventional Initiatives" package of programs that is aimed at providing the capability to both see and strike deep, denying enemy forces surprise, and threatening them throughout the length and breadth of the battlefield. In addition, there are important improvements underway in each of the major warfare areas--land, sea, and air--that are aimed at providing an effective deterrent to attack by any potential adversary.

## CONVENTIONAL INITIATIVES

The key ingredient to our Conventional Initiatives effort is the deep surveillance and strike program which supports the Airland battle and the Follow-on Force Attack concept. This program consists of a series of Joint Service, principally Army and Air Force, standoff and penetrating systems incorporating a variety of advanced technologies including low observable technology, smart munitions for top attack of armored vehicles, new all weather real-time acquisition, and micro-processing for improved data handling. The impact of these technologies is to greatly enhance our conventional defensive capability throughout the depth of the battlefield, by increasing both firepower and survivability, without increasing force structure.

The programs that constitute the core of this program are the Joint

Surveillance and Target Attack Radar System (Joint STARS), the Joint Tactical Missile System (JTACMS) and the Army Tactical Missile System (ATACMS), the Joint Tactical Fusion Program (JTFP), and the Joint Suppression of Enemy Air Defense (JSEAD).

The Joint STARS (Air Force lead) is a multi-Service, multi-function radar that has a Moving Target Indicator surveillance mode, Fixed Target Indicator spot mode, and a weapons guidance mode. The ATACMS (Army lead) is the weapons program that provides an extended range strike capability by a correctable-trajectory ballistic missile for attacking maneuver forces. It is augmented by the JTACMS (Air Force lead).

In the Air Force, these near real time attack assets will be managed through a Ground Attack Control Center (GACC). In the Army a deep strike cell combining the same standoff sensors as the GACC will be the Fire Support Element (FSE). Again, the Joint STARS will be the hub while JTFP will serve as the key target nomination source. Joint STARS will be a primary sensor input to the GACC and FSE.

The Air Force lead JSEAD and its Precision Location Strike System (PLSS), is a major component which must be integrated into the system architecture. The JSEAD is a set of tri-Service, fully coordinated programs involving both lethal and non-lethal means to suppress and/or destroy enemy air defense, associated $C^3$, and jammers.

Particularly important, as the Soviets expand the scope of their Operational Maneuver Groups (OMGs), the long range strike capability will provide lateral fires, across Corps boundaries to prevent breakthrough on the flanks. These weapons, launched either from aircraft or by ground systems, will also be used to attack command and control nodes, transportation choke points, airfields and other vital targets.

The lethality of the strike program is made possible by the smart munitions achievements. Soviet ground force equipment is susceptible to targeting by any of the three basic types of existing and proposed "supersmart" terminal guidance concepts: fly-over shoot-down; loiter-search shoot-down; hit-to-kill. Any of these types of munitions could include activating mechanisms, singly or in combination, employing technologies such as optical contrast, infrared, semi-active laser, imaging or pseudo-imaging, passive millimeter wave and active Millimeter Wave Radar (MWR).

A wide range of submunition candidates exist, from cluster bomblets to precision terminally guided submunitions. Area bomblets already in the field can be very effective when delivered accurately against many types of targets. Sensor fuzed munitions, e.g., warheads fused by relatively inexpensive sensors such as Sense and Destroy Armor (SADARM) are in development. Sensor fused munitions accurately delivered are extremely effective against any target type. These can be dispensed from a variety of air or surface delivered munition carriers. The most mature submunition concept which has been demonstrated is the autonomous hit-to-kill submunition. Such terminally guided submunitions after being dispensed from the carrier vehicle, select an individual target within their field of view and maneuver to selectively engage these targets.

These technologies, now being deployed or under system development, will dramatically improve conventional defense capability and enable day/night, all-weather engagement against moving and short dwell maneuver targets as well as interdiction of fixed targets. Attacks at the time of the Commander's choosing will have the direct effect of raising the nuclear threshold and the synergistic effect of increasing the credibility of our nuclear force posture. The overall impact of our improved conventional defense posture will enhance deterrence.

Implicit in increasing conventional deterrence is the need for our NATO llies to acquire these capabilities, for our success depends on effectiveness in the central battle and in the attack of follow-on forces across the entire front.

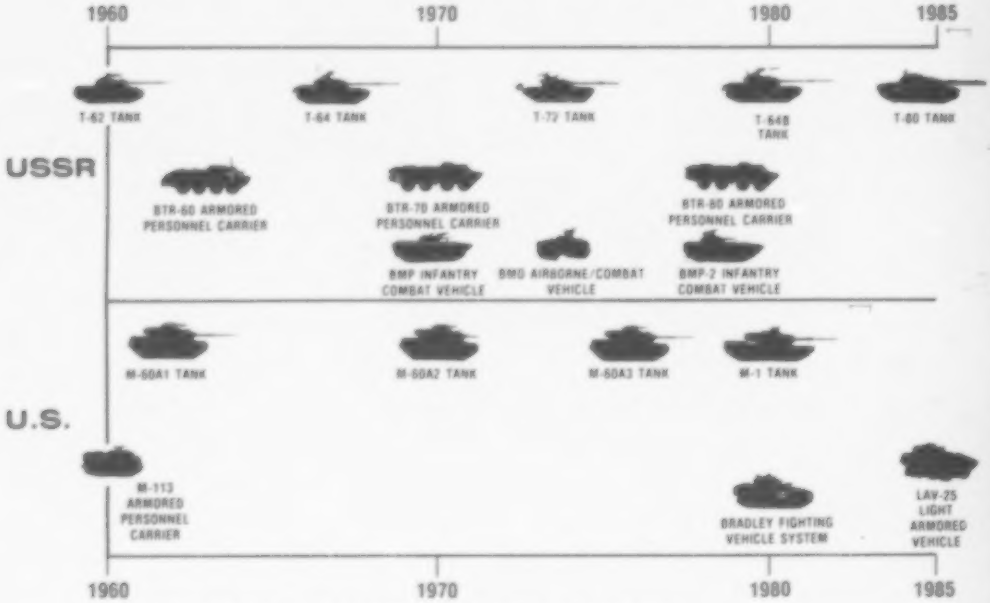
## LAND WARFARE

The past 15 years have seen technological improvements in Soviet military equipment, an expansion in the size of their ground forces, and numerous organizational changes; all of which are part of the sustained effort by the Soviets to improve and expand their ground forces. This Soviet modernization directly challenges past U.S. qualitative superiority in ground combat forces. New Soviet tanks, armored vehicles, attack helicopters, self-propelled artillery, and surface-to-surface rockets and missiles, along with new guided munitions for all of these categories of weapons, pose major threats to U.S. ground combat forces. Countermeasures, decoys and wide spread use of deception techniques will be necessary to enhance force survivability. Rapid introduction of more effective weapon systems and munitions using emerging technologies will be necessary to regain the past U.S. qualitative advantage.

Soviet ground forces include over 52,000 main battle tanks in the active inventory, of which more than one-third are modern T-64/72/80 series. Figure IV-1 shows highlights of the modernization efforts of the U.S. and USSR in armor systems since 1960. Artillery modernization efforts are highlighted in Figure IV-2.

The Soviets also plan to upgrade and expand their helicopter force to include a new helicopter currently in R&D which is similar to the U.S. Army Apache. Additionally, the Soviet inventory of infantry carriers, short range missiles, surface-to-air missiles and large caliber multiple rocket launchers continues to be modernized.

Table IV-1 shows some of the current land warfare modernization efforts by the U.S. and USSR with qualitative trends.



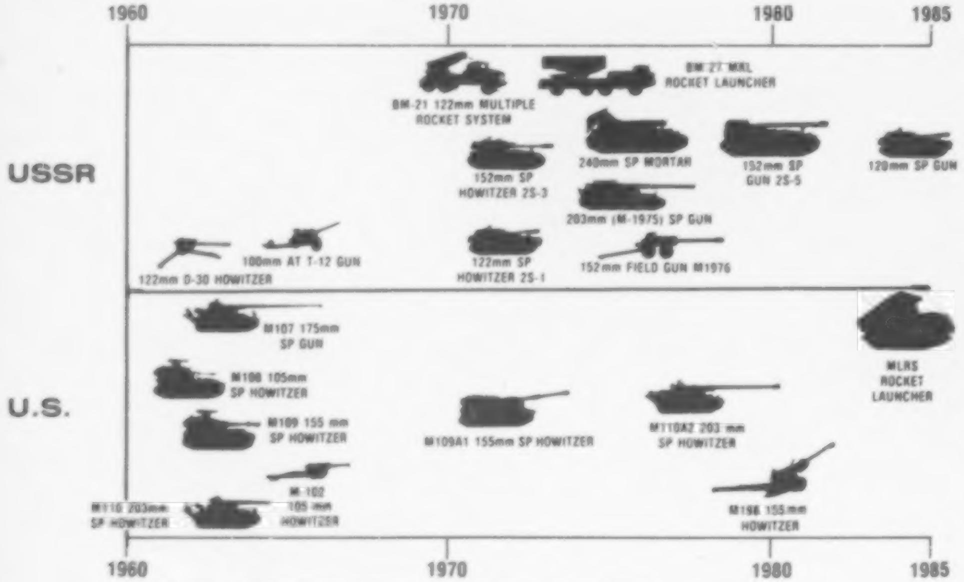
Tanks shown are both new models and major modifications. Other systems are new models only.

Figure IV-1. New and Modified U.S. and USSR Armor Systems, by IOC Date, 1960-1985

The Soviet Union and Warsaw Pact continue to outproduce the U.S. and NATO in every major category of ground combat weapon, with the exception of anti-aircraft artillery (Table IV-2).

In the close combat mission area, modernization of our tank and mechanized infantry forces continues at a high rate. The M1A1 Abrams tank with the 120mm gun, improved protection, and new Nuclear Biological and Chemical Protection systems, is now in production. Approximately 3,000 Abrams tanks, with the 105mm cannon, have been produced to date. Our inventory objective is 7467.

Recent evaluations, including a Defense Science Board (DSB) Summer Study on the U.S./Soviet armor anti-armor competition, has focused attention on the need to upgrade our tank weapons and protection. The Army is investigating a series of initiatives designed to improve the lethality of our fleet of tanks.



Tube artillery shown are 100 mm and over. Both new models and major modifications are included

Figure IV-2. New and Modified U.S. and USSR Artillery Systems by IOC Date, 1960-1985

### TABLE IV-1. U.S./USSR Ground Combat Weapons and Vehicles, Modernization Programs*

| U.S. | | USSR | |
|---|---|---|---|
| **System** | **Qualitative Trends** | **System** | **Qualitative Trends** |
| **Surface-to-Air Guns and Missile Systems** | | | |
| Patriot Surface-to-Air Missile System | • Simultaneous engagements<br>• Effective in intense ECM environments<br>• Increased mobility | SA-11, Low-to-Medium Altitude SAM System | • Has on board radar for increased mobility and target handling capability |
| Stinger, Man-Portable | • Identification, Friend or Foe<br>• All-aspect target engagement | SA-X-12, Gladiator SAM System ** | • Capability to engage tactical missiles as well as high performance aircraft. |
| | | SA-13, Gopher SAM System | • Added mobility of armored regiments with track mounted transporter-erector-launcher (TEL) |
| | | ZSU-23-4 Follow-on Self-propelled Anti-Aircraft Artillery | • Improved mobility, lethality and accuracy |
| **Armor** | | | |
| Light Armored Vehicle (LAV-25) | • More maneuverable<br>• Improved weapon accuracy<br>• Lightweight, assault capable direct fire support weapon | T-80 Tank | • Survivability versus chemical attack, nuclear effects<br>• Tank launched ATGM<br>• Substantially improved ballistic protection |
| **Guns, Artillery and Rocket Systems** | | | |
| Multiple Launch Rocket System (MLRS) | • Suppression of enemy artillery and air defense<br>• Improved follow-on warheads | 152-mm Gun | • Enhanced firepower<br>• Dual conventional/ nuclear capability |
| **Surface Launched Anti-Tank Missile Systems** | | | |
| Tow 2 | • Increased warhead lethality<br>• Ability to track through fog and smoke | Anti-Tank Guided Missile with Millimeter-wave command link | • Improved capabilities in range and lethality |

*See Table IV-6 for Attack Helicopters.

**Also included in strategic defensive modernization comparison in Chapter III.

Table IV-2. Production Summary of Selected Land Force Systems for NATO and Warsaw Pact Forces, 1976-1985*

| Category | 1976-1985 Annual Average | | | | 1985 | | | | 10-Year Trend | |
|---|---|---|---|---|---|---|---|---|---|---|
| | U.S. | USSR | NATO | Warsaw Pact | U.S. | USSR | NATO | Warsaw Pact | U.S. | USSR |
| Tanks | 735 | 2360 | 1240 | 2750 | 1375 | 2700 | 1925 | 3200 | ▲ | ▲ |
| Other Armored Vehicles<br>( Infantry Combat Vehicles) | 860<br>(210) | 4840<br>(3440) | 2010<br>(380) | 5600<br>(3760) | 1700<br>(655) | 3500<br>(2500) | 3800<br>(1055) | 3800<br>(2600) | ▲<br>▲ | —<br>— |
| Artillery, Mortars & Rocket Launchers (100mm and over) | 214 | 2860 | 484 | 3185 | 330 | 4100 | 430 | 4650 | ▲ | ▲ |
| Anti-Aircraft Artillery | 6 | 85 | 444 | 200 | 25 | 100 | 75 | 175 | ** — | — |

* See Table IV-5 for attack helicopters.

** Sgt York production cancelled beyond 1985.

Approximately 2,000 Bradley Fighting Vehicles have been produced of the planned total of 6,882. Survivability enhancements for Bradley, to keep pace with advances in the threat, are being considered at this time. Additional live fire tests are scheduled for early 1986 to evaluate design changes and product improvements necessary to increase survivability.

The Light Armored Vehicle (LAV-25) is the Marine Corps lightweight direct fire support weapon system. Initial Operation Capability of the LAV-25 was achieved in July 1984. The last of the 758 vehicles scheduled for procurement will roll off the production line in June 1987.

The vehicles which will replace all of the quarter ton through five-quarter ton trucks are the High Mobility Multi-Purpose Wheeled Vehicle (HMMWV) and the Commercial Utility Cargo Vehicle (CUCV). The multi-year production contract for the HMMWV was awarded in March 1983 with the Initial Operational Capability (IOC) achieved in September 1985. The multi-year production contract for the CUCV was awarded in July 1982 with full IOC capability achieved in July 1984.

Infantry anti-tank forces represent a vital component of the close combat mission area. Recent advances in Soviet tank armor have seriously degraded the capabilities of our family of infantry anti-tank weapons including LAW, Dragon and TOW. As a result, the department continues, on a high priority basis, to pursue programs to improve or to replace these systems with others that have increased lethality, accuracy, and effectiveness.

In the near term, TOW 2 production and TOW 2 lethality enhancements will have a substantial impact on infantry effectiveness against threat armor. Simultaneously, the Army and the Marine Corps will be acquiring the Swedish AT-4. The Army is reviewing possible approaches to procure the Shoulder Launched Multi-Purpose Assault Weapon (SMAW) (currently being procured by the Marine Corps) to improve individual soldier's effectiveness against the full spectrum of targets. A joint Army and Marine Corps effort is also underway to improve the effectiveness of Dragon.

In the far term, there are a number of promising technologies that have the potential of offering significant enhancements in force survivability and effectiveness. Programs such as the proposed replacement for the Dragon system (the Advanced Antitank Weapon System - Medium), the hypervelocity missile, and the Fiber Optic Guided Missile (FOG-M) offer extended engagement ranges, reduced gunner exposure, and enhanced lethality. The hypervelocity missile offers a new Kinetic Energy (KE) kill capability to infantry anti-tank forces. FOG-M has the potential of defeating enemy helicopters and armor (and other targets) at an extended range even when the targets are not within line-of-sight. The system is currently in Advanced Development but has demonstrated a sound technical basis for an accelerated program. The FOG-M allows an operator to "fly" a ground launched missile at extended range and to "see" a wide field of view through quality video. The operator can zoom in on a target and fly the missile to impact. The excellent potential of the FOG-M and the possible transfer of the technology to other systems is a significant factor in accelerating this effort.

Some of the most dynamic modernization efforts in the U.S. Army are being made in the Air Defense mission area. Patriot fielding is well underway with the initial units activated in U.S. Army Europe. The cooperative air defense program with the Federal Republic of Germany (FRG) will ensure the execution of the FRG's Patriot program and provides point air defense protection--with FRG manned Roland--at U.S. main operating bases in the FRG. Similarly, U.S. air bases in Great Britain are defended by British-manned Rapier Missiles. Product improvements maintain HAWK as an effective system against the evolving air threat and improve its efficiency. Research and development efforts for an Anti-Tactical Missile (ATM) capability to counter the growing conventional tactical ballistic missile threat are continuing.

In the Forward Area Air Defense (FAAD) arena, the Army has re-evaluated its doctrine and needs, following the cancellation of SGT York, and has developed an innovative concept that systematically addresses the issue from an overall force standpoint. Counterair to protect maneuver forces is to be a joint and combined effort utilizing all applicable assets (Air Force, Army, intelligence, electronic warfare, as well as dedicated air defense systems) to defeat the air threat. The execution of this new concept will rely upon an effective Command, Control, and Communication ($C^3$) system with a ground and airborne sensor capability and reliable identification means to detect and identify hostile aircraft rapidly and immediately distribute that information to weapon systems. These capabilities are embedded in FAAD $C^2I$ (formerly SHORAD $C^2$).

The remainder of the FAAD suite will consist of three additional ingredients. Line-of-sight weapon capability to defeat both fixed and rotary wing aircraft before they can deliver ordnance, a non-line of sight capability to reach into enemy territory to neutralize helicopters attempting to seek sanctuary in areas masked by terrain, and enhancements to existing combined arms systems to increase their effectiveness in countering attack helicopters. Several existing systems (prototype and production) have the potential to meet the line of sight needs. Demonstrated technologies such as FOG-M can fill the non-line of sight requirement.

Threat artillery advantages include both greater quantities and capability. The U.S. forces are now outnumbered and outranged. In answer to this critical shortfall, the Army has undertaken a Howitzer Improvement Program (HIP). The HIP will significantly increase projectile range and the mobility of 155mm Self-Propelled (SP) artillery, while also reducing the time required to initiate a fire mission. The program also adds automatic gun positioning and will improve system reliability and maintainability, survivability and NBC protection.

To increase effectiveness of artillery fire, the Army is developing the Advanced Field Artillery Tactical Data Systems (AFATDS) as a replacement for TACFIRE. The

AFATDS will increase the speed of operation, survivability and flexibility of the Command Control/Fire Direction System. In conjunction with AFATDS and the HIP program, the Army is also developing a Modular Azimuth Positioning System (MAPS). The MAPS will be an interchangeable standard modular navigation system for installation in SP weapons. MAPS will allow a significant improvement in flexibility of movement of SP weapons since the position and azimuth of each weapon will be known to the Fire Direction Center and to each individual weapon.

To increase firepower against armor, enemy artillery and other targets the Army is planning to use SADARM, sensor-fuzed submunitions in the 155mm howitzer system.

The Army is also increasing the lethality of the Multiple Launch Rocket System (MLRS) by adding a Terminally Guided Warhead (TGW) to the system. Each MLRS missile will carry six Terminally Guided Submunitions. The TGW will be autonomous, terminally homing and capable of defeating armored vehicles at medium to long range. A priority program for using SADARM with the MLRS is also underway. This initiative will take full advantage of SADARM as a fire-and-forget, autonomous munition with the ability to search an area, locate, and attack hard point targets.

Considerable improvement in the effectiveness of our firepower can be achieved by use of remotely piloted vehicles. The Army's AQUILA program is designed to provide "eyes" over the battle area and the capability to pick out targets of value and designate them for attack by laser guided munitions or provide cuing to systems such as FOG-M. The Navy/Marine Corps are also entering a program to provide reconnaissance and fire adjustment capability for their assault forces by means of a remotely piloted vehicle.

Our ground forces rely heavily on rotary wing aircraft (rotorcraft) to provide tactical mobility and highly responsive fire power. In addition, rotorcraft perform a number of support missions. The rotorcraft fleet consists of close to 10,000 helicopters of some 15 different types and over 37 model variants. While this fleet is owned by the four military Services, most of the aircraft (83%) belong to the Army. As the fleet ages--the average age of the Army's fleet is 13 years--it becomes tactically obsolete and more costly to operate. We are countering this trend with a number of product improvements and new acquisition programs.

The attack helicopter fleet constitutes slightly over 10% of the inventory and consists primarily of the Cobra (AH-1) series of gunships. Since its introduction in the 1960's, the AH-1 has undergone numerous modifications by both the Army and the Marine Corps to improve its tactical utility and survivability. The current product improvement programs are the C-Night upgrade which provides night capability for the Army's TOW-carrying AH-1S's and a major performance upgrade for the Marine Corps' AH-1T's to increase their engine power and to allow for the firing of the Hellfire laser guided anti-armor missile as well as the TOW missile. The Marine Corps program also provides air-to-air capability by incorporating the Sidewinder missile. The ongoing Apache (AH-64) acquisition program provides a major upgrade of the Army's attack helicopter fleet. Compared to Cobra, the Apache will provide large improvements in targeting, lethality in killing armored vehicles, and night operations. In addition to this program, the Army is in the early stages of developing a new light helicopter, the LHX, that will replace a large fraction of the aging fleet and provide new capabilities for scout, attack and utility missions that will counter emerging and projected threat developments. LHX will exploit a number of maturing technology based programs including: (1) new materials that are lighter, more ballistically tolerant and more temperature resistant; (2) simplified, yet more efficient and capable cockpits to allow single pilot nap-of-the-earth operations in day/night/adverse weather; and (3) more effective maintenance diagnostics/system monitoring capability to decrease maintenance demands. Other areas where maturing technology is rapidly becoming available include reduced signatures to minimize aircraft detectability, therefore increasing survivability, and more robust subsystems capable of withstanding adverse operating conditions.

Over 2,000 of our light helicopters are dedicated to the scout, command and light utility missions. Improvements to this fleet are made through the Army Helicopter Improvement Program (AHIP) which will modify a portion of the OH-58C inventory providing them with increased flight performance and a day/night target acquisition and designation capability.

## NAVAL WARFARE

As measured by numbers of ships and procurement expenditures, the United States and its allies maintain a favorable balance of maritime power. During the past 25 years, however, the Soviet Navy has conducted a significant, sustained modernization program that has steadily improved its combat capabilities.One of the dramatic military developments since the early 1960's has been the appearance of the Soviet Navy on the world's oceans.Previously, the Soviet fleet spent virtually all its time in port or in home waters, its open ocean capability sharply limited by poor training. Although Soviet naval activity has increased markedly since then, we remain confident of the qualitative superiority of the U.S. and NATO fleets in training and materiel readiness for war.

Figure IV-3 compares major surface combatant inventory value of the U.S. and USSR. It shows that the inventory value of Soviet major surface combatants has steadily increased for the past 20 years as a result of their persistent, sustained program. Figure IV-4 compares the inventory value of attack submarines. It shows that the higher production rate of Soviet submarines has resulted in a steadily increased force of substantially greater inventory value than the U.S.

In the past three years, three new classes of nuclear-powered attack

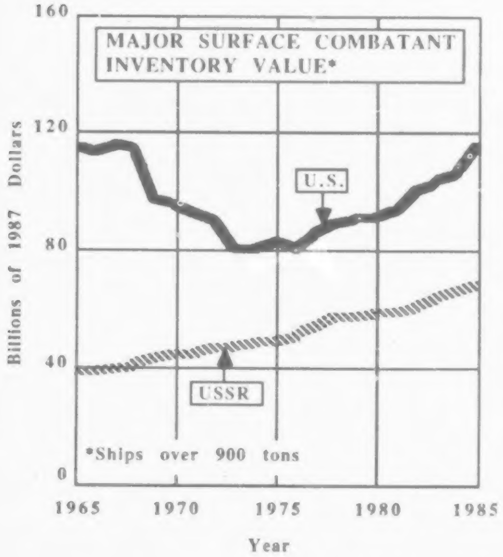


Figure IV-3. U.S. and USSR Major Surface Combatant Inventory Value, 1965-1985

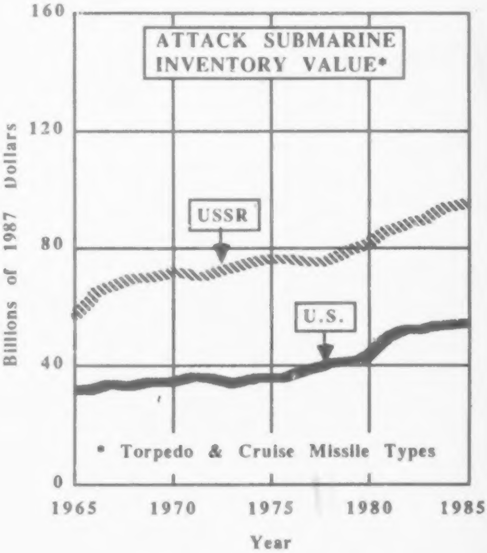


Figure IV-4. U.S. and USSR Attack Submarine Inventory Value, 1965-1985

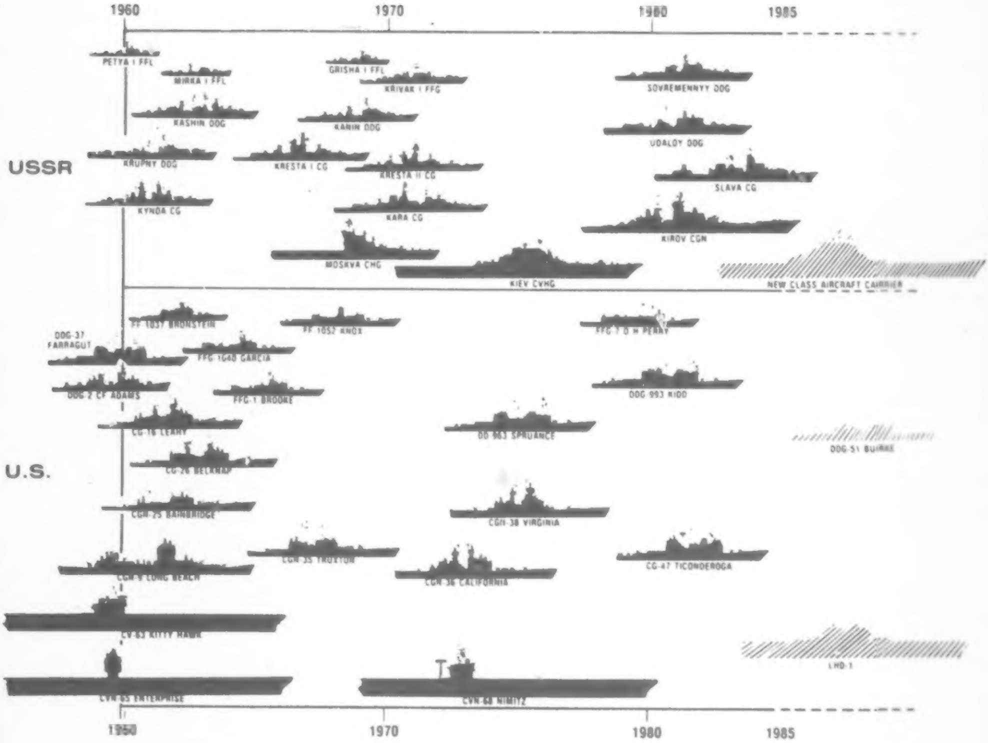
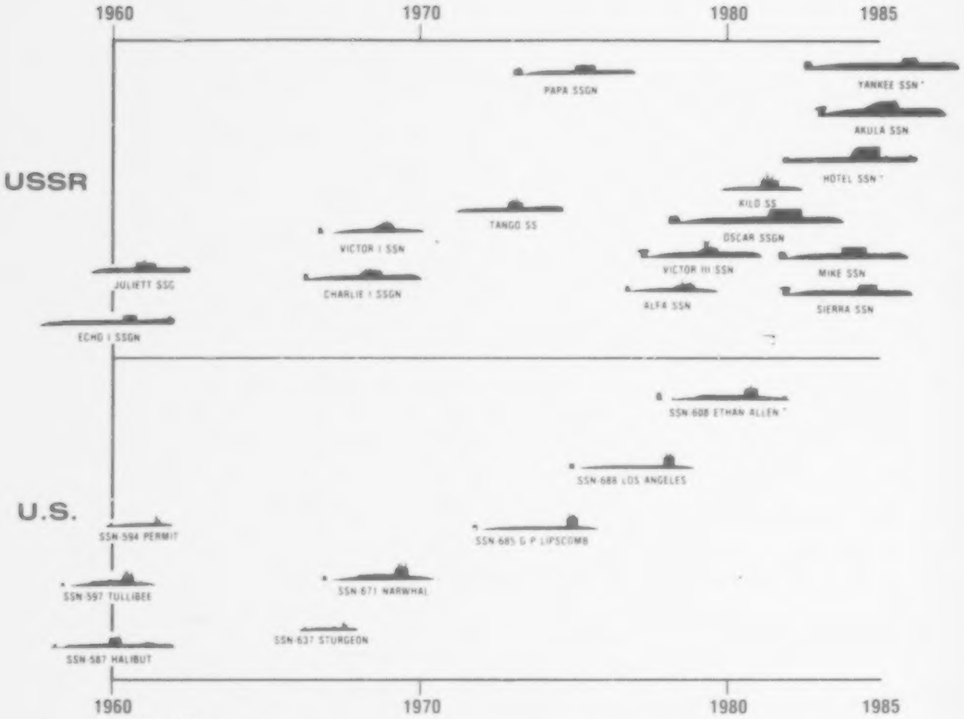


**Figure IV-5. New U.S. and USSR Major Surface Combatant Classes, by IOC Date, 1960-1965**

submarines were launched by the Soviets--MIKE, SIERRA, and AKULA. The diversity of the Soviet submarine force is complemented by continuing production of the diesel-powered KILO class attack submarine.

Figures IV-5 and IV-6 provide an illustration of representative naval warfare acquisition efforts of the U.S. and USSR since 1960.

Construction of a large aircraft carrier (65,000 tons displacement) by the Soviets continues. As described last year, completion is expected before the end of the decade. The second nuclear-powered guided missile cruiser,



*CONVERTED SSBNs

Figure IV-6. New U.S. and USSR General Purpose Submarine Classes by IOC Date, 1960-1965

FRUNZE, has joined the Fleet, and a third ship of the class continues under construction on building ways in Leningrad.

Table IV-3 provides a qualitative summary of naval modernization efforts on both sides.

The Soviet modernization effort extends across a broad front and includes:

- improved sea based tactical air capability when the large new aircraft carrier goes to sea;
- expansion of the anti-air and anti-missile defense capability of surface task groups (the SLAVA, FRUNZE and KIROV guided missile cruisers, for example); and

## Table IV-3. U.S./USSR Naval Warfare Modernization Programs

| U.S. | | USSR | |
|---|---|---|---|
| **System** | **Qualitative Trends** | **System** | **Qualitative Trends** |
| **Major Surface Combatants** | | | |
| CG-47 Aegis Cruiser | • Quick reaction<br>• High firepower<br>• Improved ECM assistance in AAW | New Class Aircraft Carrier | • Possible capability to launch and recover high performance tactical aircraft |
| DDG-51 Guided Missile Destroyer | • Quick reaction<br>• Multi-mission<br>• Operates offensively and defensively | Kirov CGN | • Nuclear powered<br>• Increased offensive (long- range anti-ship) and improved (area) defensive (anti-air/anti-cruise missile) firepower |
| LHD-1 Amphibious Ship | • Adds stand-off amphibious capability | Slava CGN | • Increased offensive power as above |
| | | Udaloy DDG | • Advanced air defense and ASW systems |
| | | Sovremennyy DDG | • Advanced air defense and naval gunfire capabilities |
| **Submarines** | | | |
| | | Mike-class SSN | • Increased size<br>• Advanced hull and propulsion technology<br>• Torpedo tube launched cruise and ASW missiles |
| | | Sierra-class SSN | • Significant quieting<br>• Improved sensors<br>• Torpedo tube launched cruise and ASW missiles |
| | | Akula-Class SSN | • Improved sensors<br>• Torpedo tube launched cruise and ASW missiles |
| **Anti-Submarine Helicopters** | | | |
| Lamps Mk III ASW System | • Expanded ASW Capability | Ka-27 (Helix) ASW | • Advanced airframe and ASW systems technology |
| **Missiles and Torpedoes** | | | |
| Sea Level ASW Stand-Off Weapon | • Improved stand-off ASW capability | SS-N-22 Anti-Ship Missile | • Increased speed (Supersonic) and low altitude penetration capability<br>• Improved ECCM |
| Rolling Air Frame Missile | • Improved cruise missile defense | Torpedo | • Increased size<br>• Increased range<br>• Increased speed<br>• Improved warhead |
| Mark 50 Torpedo | • Improved speed and endurance | | |
| Mark 48 Adcap | • Improved speed depth and homing capability | | |

- intensification of the open-ocean capability of Soviet submarines (the MIKE, SIERRA, and AKULA class SSNs) and their transition toward multi-purpose forces through installation of torpedo tube-launched ASW and land-attack cruise missiles.

In response to the increasing combat capability of Soviet naval forces, the more noteworthy developments in current U.S. acquisition programs are aimed at improving our anti-missile capabilities (through the CG-47 AEGIS cruiser and DDG-51 guided-missile destroyer programs) and improvements in ASW and land-attack cruise missiles capabilities (through the SSN-21 class submarine, the LAMPS ASW helicopter, maintaining our highly leveraged advantage in attack submarine apabilities and improved ASW missiles and torpedoes). The SSN-21 program is critical to maintaining our highly leveraged advantage in attack submarine capabilities. During FY 1987, we will be producing the detailed drawings and supporting documentation needed to begin construction of the ship.

The magnitude of the Soviet shipbuilding program is shown in Table IV-4. They are producing about the same number of major surface combatants as the U.S., although they do not have the sea lane defense requirements of the U.S. Navy.

Figure IV-7 points to one of the factors that drives force acquisition: age. It shows the number of U.S. and Soviet major surface combatants and general purpose submarines that are already more than 20 years old and are candidates for replacement, due simply to wear and tear, without regard to technological sophistication. The problem of an aging block of ships, all built within a few years of each other, was one that the U.S. faced in the late 1960's and early 1970's. The Soviets are now facing a similar problem in terms of fractions of existing forces coming up for replacement. The implications are several: Procurement budgets will likely be stressed, and difficult force level decisions will have to be made. But perhaps more importantly, the need for force acquisition creates the opportunity, on both sides, for the enhancement of force leverage through application of advanced technology to the acquired forces. Because of this opportunity for application of advanced technology available to the Soviets, we must commit ourselves to a continuous effort of force leverage enhancement through superior technology and to constraining technology transfer to the Soviet Bloc.

### Table IV-4. Production Summary of Naval Vessels for NATO and Warsaw Pact Forces, 1976-1985

| Category | 1976-1985 10-Year Total | | | | 1985 | | | | 10-Year Trend | |
|---|---|---|---|---|---|---|---|---|---|---|
| | U.S. | USSR | NATO | Warsaw Pact | U.S. | USSR | NATO | Warsaw Pact | U.S. | USSR |
| Major Surface Combatants | 90 | 85 | 192 | 110 | 8 | 8 | 16 | 13 | — | — |
| Amphibious Ships | 7 | 21 | 9 | 32 | 2 | 2 | 2 | 2 | ↑ | — |
| Attack Submarines | 33 | 64 | 62 | 68 | 3 | 6 | 5 | 6 | — | — |

The Soviets have elected not to develop a large underway replenishment ship force for an offensive surface role in the open oceans against major opposition, and their surface combatant force includes only a few ships (KIROV and SLAVA classes) with the new SA-N-6 anti-air area defense system. Thus, we continue to regard the attack submarine force and the long-range, missile-armed, land-based bomber force as the principal threats to U.S. maritime forces.

Three important initiatives to our naval warfare mission area have been undertaken to improve overall maritime force capability. First, concern for the defense of our overseas bases, forward-deployed battle groups, and sea lanes against air and surface threats has led us to examine our ability to detect and track these threats over oceans and littorals vital to our maritime interests. Our evaluation shows that, to fulfill our defense goals, we need surveillance sensors that can cover broad areas nearly simultaneously. Because such broad surveillance involves forces and systems that are multi-Service and multi-national, DoD oversees the effort through the Maritime Anti-air Warfare Executive Committee (MAAWEC) co-chaired by the Under Secretary of Defense for Research and Engineering and the Director, Program Analysis and Evaluation. The MAAWEC has made recommendations to achieve the best balance among maritime surveillance programs such as Over-the-Horizon Radars (OTHRs), conventional line-of-sight microwave radars, and spaced-based assets. Important joint initiatives with several Allies have been undertaken and are well on the way to implementation.

The second initiative concerns the broader area of maritime anti-air

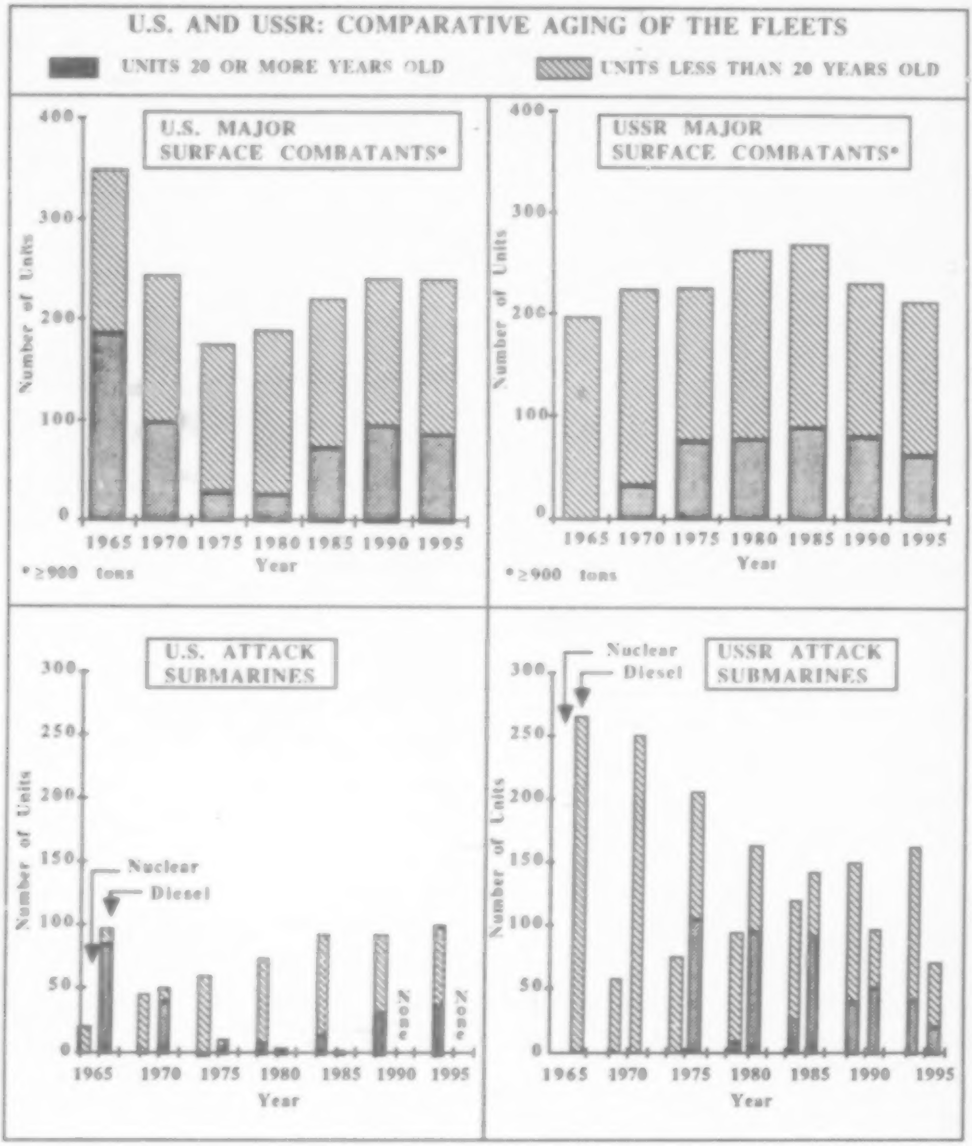


Figure IV-7. Age of The Fleets--U.S. and Soviet Major Surface Combatants and Submarines, 1965-1995

warfare investment planning. The MAAWEC proposed an investment strategy that encompasses both land- and sea-based forces in broad maritime regions, such as the Norwegian Sea Mediterranean, and Northwest Pacific. The Committee has recommended a general plan for the development of naval surface-to-air missiles that was presented to Congress by the Secretary of Defense in early 1984, and has followed up to assure execution of that plan. In concert with the Services and the Unified and Specified Commands, the Group has outlined the significant elements of a broad strategy for regional maritime air defense and has been working to convey it throughout the Navy and Air Force.

The third initiative concerns identification of advanced programs and technologies that will become necessary for successful Anti-Submarine Warfare (ASW) against the improving Soviet threat. The previously mentioned SSN-21 is a critical part of the answer, but the problem is much broader.

## AIR WARFARE

The across-the board qualitative and quantitative improvements that have taken place in the other branches of the Soviet armed forces during the past two and one-half decades are strikingly evident in the category of tactical air warfare. Figure IV-8 depicts different types of fixed-wing aircraft introduced by the U.S. and the Soviet Union during this period.

The Soviet Union has introduced more different aircraft types during this period. Of greater significance, however, is the major qualitative advances represented by the introduction of FULCRUM-A/ FLANKER-B/FOXHOUND. While the U.S. maintains a technological lead, its magnitude has been reduced by the increased levels of sophistication and capability incorporated in newer Soviet aircraft. This increased capability includes advanced air-to-air radars and missiles providing all-weather, all aspect, look-down/shoot-down capabilities on their interceptors and increased range/payload capabilities on their attack aircraft.

Additionally, a summary of tactical aircraft produced from 1976 to 1985 shows that the Soviet Union has outproduced the U.S. by a factor of over two. NATO production also lags that of the Warsaw Pact (Table IV-5).

Because the Soviet Union procures more aircraft than the U.S., and because the newer systems are increasingly more sophisticated and capable than past models, Soviet aircraft inventory

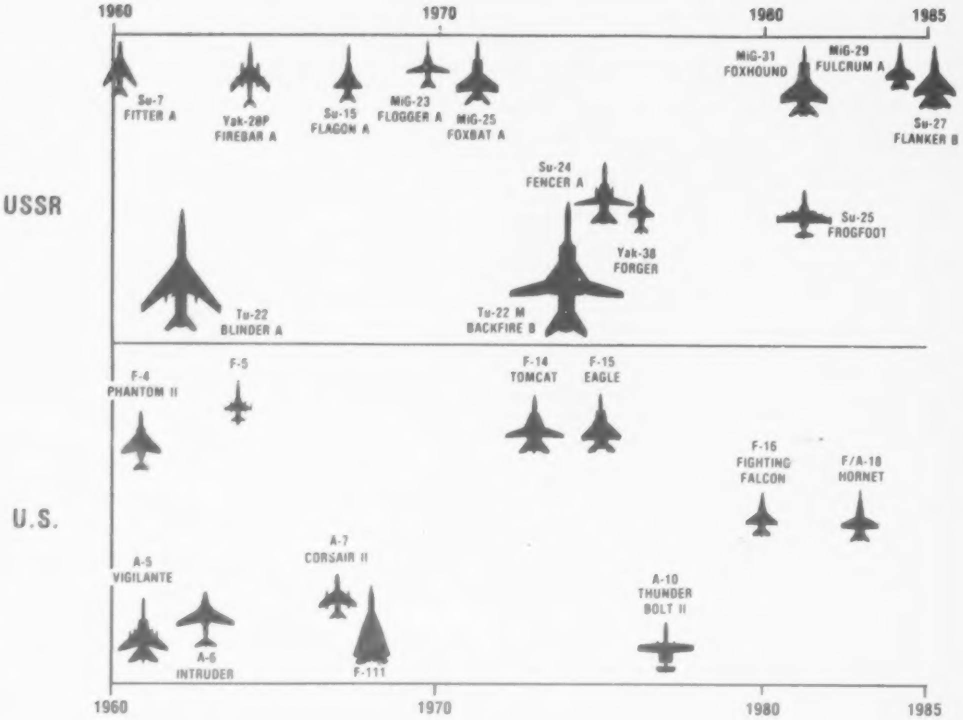


Figure IV-8. New U.S. and USSR Strategic Interceptors, Theater Bombers, Tactical Fighters and Attack Aircraft by IOC Date, 1960-1985

Table IV-5. Production Summary of Selected Tactical Aircraft for NATO and Warsaw Pact Forces, 1976-1985

| Category | 1976-1985 Annual Average | | | | 1985 | | | | 10-Year Trend | |
|---|---|---|---|---|---|---|---|---|---|---|
| | U.S. | USSR | NATO | Warsaw Pact | U.S. | USSR | NATO | Warsaw Pact | U.S. | USSR |
| Fixed-Wing Combat * | 360 | 790 | 720 | 895 | 320 | 700 | 740 | 750 | — | — |
| Rotary Wing | | | | | | | | | | |
| Attack Helicopters | 45 | 205 | 105 | 220 | 50 | 250 | 100 | 250 | — | ↑ |
| Other Military Helicopters | 110 | 330 | 375 | 370 | 185 | 300 | 335 | 325 | ↑ | — |

* Includes strategic defense interceptors and ASW aircraft.

value has increased much faster and is estimated to have exceeded that of the U.S. during the past decade (Figure IV-9).

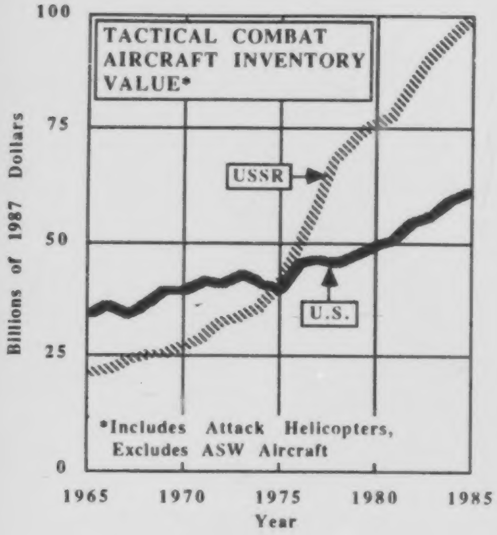


Figure IV-9. U.S. and USSR Tactical Combat Aircraft Inventory Value, 1965-1985

These trends are a matter of concern since tactical air is an area in which it is essential that we maintain the advantage. As a means of maintaining the technological advantages the U.S. depends on to counter the Soviet numerical superiority, we are aggressively pursuing programs both to enhance the capabilities of current front-line tactical aircraft/weapons and to develop new aircraft/systems/weapons.

In the near-term for our Counter-Air mission area, we must be able to defeat the increased threat represented by the introduction of current generation aircraft and missiles. With regard to our current front-line aircraft, we have undertaken a series of carefully planned Multi-Stage Improvement Progams (MSIP) and block upgrades. Qualitative trends are shown in Table IV-6 and succeeding paragraphs provide amplifying details.

The first F-15E aircraft will be delivered to the USAF in FY87. F-15E retains the basic air superiority capability of the F-15 multi-stage improvement aircraft and adds significant air-to-ground capability. The aircraft will be capable of long-range interdiction missions with its improved range/payload and low-altitude, all-weather capabilities. Many of the improvements to the F-15E weapons system have evolved from the development of other aircraft, in particular the F/A-18. This evolutionary development of advanced systems' capabilities has a high leverage effect and is a recurrent theme in recent research and development efforts with standardized computer languages, data transfer bases and common hardware directed where applicable.

## Table IV-6. U.S./USSR Aircraft Modernization Programs

| U.S. | | USSR | |
|---|---|---|---|
| **System** | **Qualitative Trends** | **System** | **Qualitative Trends** |
| **Fixed-Wing Combat Aircraft** | | | |
| F-15E | • Enhanced air-to-air capability<br>• Significant air-to-ground capability | Su-27 (Flanker B) | • Look-down/shoot-down fighters; improved air combat agility |
| F-16 MSIP | • Software and avionics upgrades for increased air-to-air and air-to- ground capabilities | MiG-29 (Fulcrum A)<br>MiG-31 (Foxhound)* | • Possible ground attack role<br>• Improved capability to engage low altitude aircraft and cruise missiles |
| F/A-18 Hornet | • Increased weapons load<br>• Operational flexibility | | |
| F-14A upgrade/ F-14D | • Upgraded avionics<br>• Increased reliability<br>• Standardized digital hardware/software<br>• Higher performance engine | | |
| EF-111A Tactical Jamming Aircraft | • Provides electronic countermeasures (ECM) protection to tactical aircraft | | |
| **Helicopters** | | | |
| AH-64A Apache Attack | • Improved speed and agility<br>• Night and all weather capability<br>• Target detection/designation capability<br>• Advanced avionics and armament | Mi-26 (Halo)<br>Mi-28 (Havoc)<br>Hokum A | • Heavy payload, long range<br>• Increased speed, agility, night and all weather capability<br>• Fighter helicopter with air-to-air capability (world's first) |
| OH-58D AHIP (Army Helicopter Improvement Program) | • Improved Nap-of-the-earth (NOE) navigation and communications<br>• Day, night and adverse weather operations world wide<br>• Provision for air-to-air Stinger<br>• Enhanced vision equipment for target acquisition and designation | | |

*Also included in strategic defense modernization comparison in Chapter III.

The F-16 MSIP continues to advance the capabilities of the aircraft's air-to-air and air-to-ground capabilities as software and advanced avionics systems develop. In particular, state-of-the-art cockpit displays, electronic warfare suites and a Beyond-Visual-Range (BVR) missile capability are being incorporated to make the aircraft all-weather operable. Long-term procurement plans indicate that the F-16 will continue to be a major portion of the USAF force structure as well as an important part of many other free world countries.

The F/A-18 has completed its first operational deployment with documented readiness and maintainability that exceeded its expectations. The inherent flexibility of the Navy's first true strike-fighter has provided Battle Group Commanders with operational options and flexibility never before possible. Early design that placed heavy emphasis on operability, reliability, and maintainability have made the F/A-18 the new standard for readiness and are being applied to advanced programs for follow-on aircraft.

The F-14 is being upgraded by production/retrofit of the F-14A, which features a new engine and improved ECM. An additional improvement is the F-14D which incorporates upgraded F-14A advances and adds an improved radar and upgraded avionics. The upgraded F-14A and F-14D will begin production in FY86 and FY88 respectively.

Across the board, aircraft operational readiness and sustainability goals are being maintained at unprecedented levels through a combination of state-of-the-art fault analysis systems and maintenance techniques, flexible test support equipment and adequately stocked spares support. Recent history has shown large payoffs from our investments in these areas and we intend to continue those upfront investments.

Engine improvements represent an important part of our fighter upgrade program. Near term emphasis has been on enhanced reliability, supportability, and readiness as well as increased aircraft maneuver capability. Qualification of the F100-PW-220 and F110-GE-100 engines has been completed and introduction into F-15 and F-16 aircraft squadrons will soon begin. A varient of the F110-GE-100 engine will go into the upgraded F-14A and F-14D aircraft. Efforts are underway to develop/qualify increased performance versions of these engines as well as the F404-GE-400 engine in the

F/A-18. In the longer term, the Joint Advanced Fighter Engine (JAFE) entered the demonstration/validation phase of development in FY85 and will enter Full Scale Development in FY89.

Important complements to the aircraft are improved combat identification systems, automated command and control systems for airspace management and improved airborne surveillance and control capability. Production of upgraded Sidewinder, Sparrow, and Phoenix missiles continues. Current versions of these missiles feature improved reliability, Counter-Countermeasure (CCM) capability and ground clutter resolution. The Advanced Medium Range Air-to-Air Missile (AMRAAM) is the next generation missile being developed for the Air Force, Navy, and our NATO allies. AMRAAM will provide increased velocity, better maneuverability, a more lethal warhead, improved terminal guidance, multiple launch/launch-and-maneuver capabilities and improved CCM. The missile, which entered flight test during the past year, will be an effective force multiplier when it is introduced to operational forces in 1989.

To counter anticipated introduction of future Soviet advanced tactical aircraft, development has begun on the Advanced Tactical Fighter (ATF). This aircraft, which will begin replacing the F-15A in the mid-1990's, will fulfill the requirements for greater combat radius, more rapid deployment capability, reduced logistics support and improved survivability. These requirements will be met through incorporation of advanced integrated avionics architectures, Very High Speed Integrated Circuit (VHSIC) technology, digital flight controls, aerodynamic refinements and other advanced technology developments. Improved reliability and maintainability are priority goals. Selection of three or four contractor teams will occur in FY86. These teams will demonstrate/validate respective ATF concepts through detailed design analysis, mission effectiveness testing and wind tunnel testing. The Demonstration/Validation phase, continuing through FY89, will place heavy emphasis on risk-reduction efforts on key ATF technologies and lead to selection of a single design in FY89.

Suppression of Enemy Air Defense (SEAD) is a priority mission in carrying out the objectives of the TACAIR attack missions. The Soviet Union has an integrated system of surface-to-air missiles (SAMs) and Anti-Aircraft Artillery (AAA) that is the most comprehensive network of ground air defense in the world. Over 4600 SAM launchers and 12,000 AAA pieces are deployed at regimental through front-level. As many as 25,000 shoulder-fired SAM launchers are at lower levels. The largest concentration of SAM launchers and AAA pieces--over 8,000--is found opposite NATO. In addition, there are 4500 in the Far East, over 2500 in Southwest Asia and opposite Eastern Turkey, and over 1600 in strategic reserves. As many as 25,000 shoulder-fired SAMs are also deployed with the Soviet Ground Forces. Soviet production of surface-to-air missiles continues at a rate of about 55,000 per year. This compares to about 5,000 for the United States. Figure IV-10 shows the extent of the USSR land-based SAMs in relation to the U.S. missiles. Sea targets are defended by gun systems and SAMs that are ship-launched versions of the land-based SAMs shown in Figure IV-

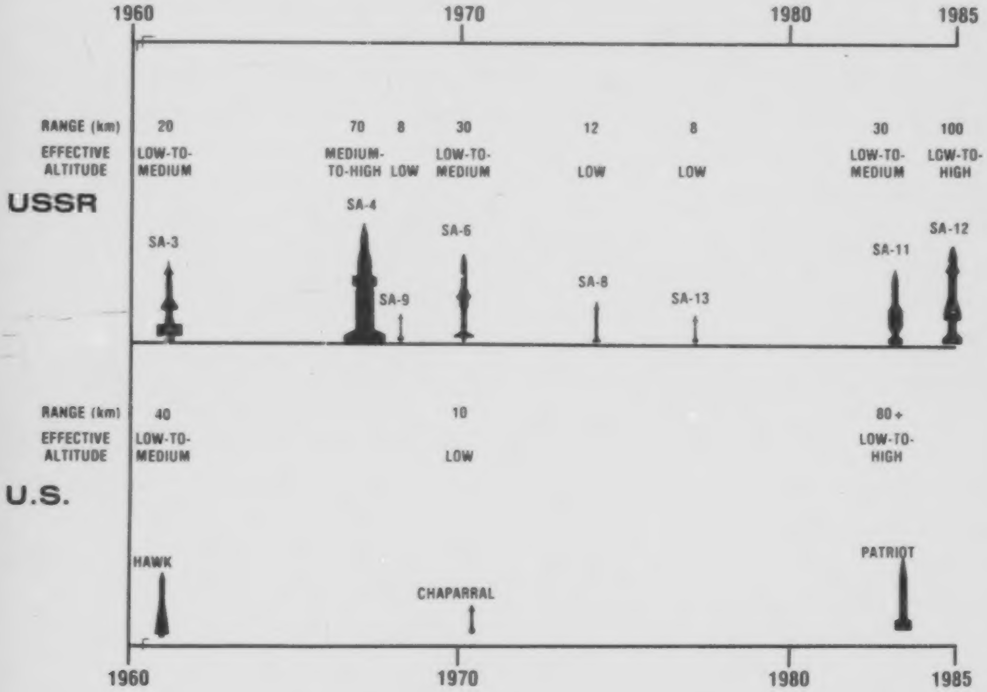


Figure IV-10. New U.S. and USSR Tactical Land Based SAMS, by IOC Date, 1960-1985

10. As previously mentioned, both ROLAND and RAPIER are foreign missiles which are used to defend U.S. Air Bases in Europe and are not included in Figure IV-10.

We are acquiring the Precision Location Strike System (PLSS) which can locate air defense emitters in near real-time, and provide this information for targeting standoff weapons. It will enhance the effectiveness of the EF-111 jamming aircraft and F-4G Wild Weasel by cuing them to their targets.

The EF-111 Raven provides tactical jamming of early warning, acquisition, and ground control intercept radars in support of United States and allied tactical strike operations. It denies enemy command and control centers the necessary range, azimuth, and altitude information needed to cue interceptors, surface-to-air missiles and anti-aircraft artillery. To counter Soviet advances, updates are in development closely coordinated with the Navy EA-6B update effort to avoid duplication and provide synergistic results for both programs.

The F-4G Wild Weasel can automatically detect, locate, engage, and destroy hostile radars. The APR-38 Radar Warning and Attack System is the backbone of the F-4G. We are upgading this mid-1970's design by increasing the capacity of the on-board computer, increasing receiver frequency range, and increasing system processing speed. These updates will allow the Wild Weasel aircraft to fully exploit the capabilities of the High Speed Anti-Radiation Missile (HARM).

The HARM provides a destructive counter to sophisticated enemy ground-based radar guided missile systems, and anti-aircraft artillery systems which threaten our tactical aircraft. Production of HARM is continuing at increased and more efficient rates. Software updates are being developed to counter steadily improving threats. In addition, the HARM low cost anti-radiation seeker development continues with potential application in various missile configurations.

In the GBU-15/AGM-130 program, a family of modular guided weapons is being developed to destroy high value point targets and enemy defense sites. The GBU-15 is a glide bomb equipped with a Television (TV) or Imaging Infrared (IIR) seeker. The AGM-130 is a rocket-powered version of the GBU-15. A highly accurate medium-standoff weapon, the AGM-130 responds to the improving enemy air defense systems by moving the attacking aircraft further from the target. The GBU-15/TV version is in production and will be used by F-4E, F-15E and F-111F aircraft. The GBU-15/IIR version is in final testing and will provide a night attack capability. AGM-130 development began last year and early testing will begin during FY 1986. It will also be carried by the F-15E, the F-4E, and F-111F.

The Close Air Support (CAS) Mission is usually conducted when friendly ground forces are immediately threatened by superior opposing ground forces. CAS forces must be capable of defeating a variety of targets that include tanks, armored personnel carriers, artillery, other armored vehicles, and air defenses. Often the mission must be conducted when enemy ground forces are well defended by air defenses making multiple passes hazardous. The Warsaw Pact (WP) has continued to stress highly mobile, well-defended mechanized forces. Warsaw Pact modernization efforts include countermeasures against our CAS capabilities such as the use of obscurants, increased vehicle protection (passive and reactive armor) and improved tactics for day/night operations.

To increase our weapon effectiveness under a wide range of lighting conditions, we are fielding infrared weapons such as the day/night capable IIR MAVERICK, and laser MAVERICK for use on the AV-8B, A-10, and other air platforms. We are also procuring the proven 30mm gun pods for use by A-7's and F-4's in the Air National Guard (ANG). To obtain high sortie effectiveness, we are developing the tri-Service hypervelocity missile which promises to provide multiple-kills-per-pass for fixed wing and rotary wing aircraft.

For attack of enemy airfields we are developing standoff weapons including the AGM-130 as well as short range, low cost systems such as the Direct Airfield Attack Combined Munition (DAACM) to complement DURANDAL. In the past four years, we have introduced to production and in the inventory the IIR GBU-15, LLLGB, and advanced capability MAVERICKS. Each weapon possesses unique, complementary capability against a spectrum of tough, hard targets. A summary of our aircraft weapon modernization efforts is provided in Table IV-7.

The Air Force has accelerated its efforts to develop a Hardened Target Munition (HTM) for use against the expanding array of hard land targets. This munition is being developed for use with developmental standoff weapons and initially will be compatible with

## Table IV-7. U.S. Air-Launched Weapons Modernization Programs

| MISSILE SYSTEM | IMPROVEMENTS |
|---|---|
| **AIR-TO-SURFACE** | |
| JTACMS | – Long standoff range, day/night operation, high effectiveness.<br>– Multiple payload. |
| GBU-15 | – IIR seeker for day and night operation. |
| Powered GBU-15 (AGM-130) | – Increased standoff for improved aircraft survivability.<br>– Submunition and unitary payload for increased effectiveness and flexibility. |
| MAVERICK | – Effective Anti-Armor missile for fixed wing aircraft.<br>– Laser and IIR for day and night operation. |
| HELLFIRE | – Effective Anti-Armor missile for helicopters.<br>– Laser guidance for precision and control. |
| HARPOON | – Improve reliability.<br>– ECCM upgrade. |
| WALLEYE ER/HDL | – Improved standoff range.<br>– Minimize susceptibility to countermeasures. |
| SKIPPER | – Powered laser guided bomb for standoff anti-ship.<br>– Low cost compliment to Harpoon. |
| DURANDAL | – Effective airfield runway buster. |
| DAACM | – Efficient airfield attack munition. |
| SFW/SKEET | – Multiple armor kills per pass.<br>– Superior Cost/Effectiveness cluster munition. |
| GATOR Mine | – State-of-Art anti-armor, airfield mine. |
| LLLGB | – Increased accuracy and low-level capability |
| HARM | – All-weather missile to destroy enemy radar<br>– Broad-band frequency coverage. |
| **AIR-TO-AIR** | |
| SIDEWINDER | – Improved infrared CCM<br>– Improved clutter rejection |
| SPARROW | – All aspect/all weather attack<br>– Improved look down/shoot down |
| AMRAAM | – Multiple engagements against ECM<br>– Improved speed and agility |
| PHOENIX | – All aspect/all weather attack against multiple targets<br>– Broad ECCM capabilities |

current laser guided weapons kits. The Air Force JTACMS, which has completed system definition, will provide the versatility to accomplish many of the strike missions with different warheads.

To help our tactical aircraft deliver these new weapons more effectively, we are developing advanced sensors to enhance navigation, target acquisition, weapon delivery, and overall survivability. The two pod LANTIRN system is programmed for Air Force F-15E and F-16C aircraft. The navigation pod entered production this past year and will permit highly survivable, low level, high speed penetration at night. The targeting pod is completing testing and will enter production with a decision scheduled for May 1986.

The Navy is upgrading the A-6 aircraft with a more reliable avionics digital system with many components standardized across the AV-8B, F/A-18, F-14, and A-6 fleets. To enhance survivability, the new precision attack radar of the A-6 will permit robust operation in an ECM environment as well as provide resolution and identification of ship targets for first pass attack with standoff weapons. The Navy will also extend the night capability of the AV-8B, A-6, and F/A-18 by developing a combination of night vision goggles and wide-field-of-view infrared imaging sensors.

The Navy has hardened the WALLEYE data link for effective operation in the high threat environment, as well as deployed the extended range WALLEYE I. The Navy's laser guided SKIPPER has been outfitted to all deployed carrier air wings. Its low cost, moderate standoff capability makes it effective against the smaller, less defended ships and provides a good compliment to the radar guided HARPOON, our long range anti-ship weapon.

The Navy is also investigating a new strike weapon, as part of its Conventional Strike Weapons Plan, which will have precision guidance, good standoff range and be widely deployed in the fleet. These strike systems are expected to result in much increased launch platform survivability and enable us to operate effectively in the high threat environment.

## CONVENTIONAL MUNITIONS

The preceding discussions on the Tactical Warfare mission areas have made numerous references to our initiatives in conventional munitions. This section summarizes our recent increased emphasis on acquiring modern, conventional munitions. Our acquisition strategies for conventional munitions are heavily threat-oriented. While most of the munitions are intended for multi-mission application, the defeat of a specific target class typically drives the design. This statement is particularly true with respect to our anti-armor munitions. In this regard, anti-armor munitions are very demanding in that a large amount of impact energy must be delivered to the target with a high degree of accuracy.

During the first half of this decade, we have made considerable progress in increasing the quality and quantity of conventional munitions (Figure IV-11). Each bar shows the sum of gun-launched munitions and missiles expressed in constant FY86 dollars. During the period following the Vietnam draw-down, the munitions accounts were fairly constant. Starting in FY83 there is a significant upward trend in the munitions accounts. Both types of munitions show significant increases in the four year period between FY83 and FY86. The largest percentage increase occurs with missiles.

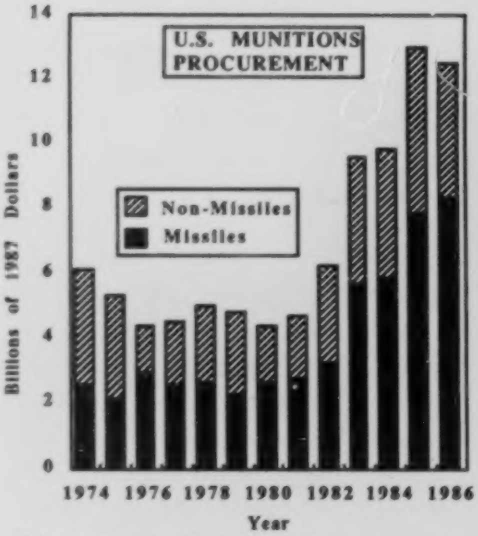


Figure IV-11. Munitions Procurement, 1974-1986

Current emphasis on conventional munitions is centered on applying the technology of recent advances in electronic components and computer processing into advanced seekers, sensors, and fuzes. These, coupled with new warhead technologies, form the basis for the DoD thrust in smart munitions. As the DoD Budget demonstrates, we have made a considerable R&D commitment to development of smart munitions such as the Air Force's Sensor Fuzed Weapon (SFW) and the Army's SADARM and Smart Target Activated Fire and Forget (STAFF). These munitions utilize advanced directional fuze concepts and Explosively Formed Penetrator (EFP) warheads. They are not guided munitions and, therefore, are expected to be much less costly than terminally guided munitions. By effectively managing the assignment of the smart munitions to be employed against the different targets, it is possible to further optimize the force multiplier effect of a given stockpile of modern munitions. All three Services are working on the battle management task.

From a cost effectiveness standpoint, it would be highly desirable to replace the existing stockpile of conventional munitions with new modern munitions. This is not affordable since our current investment in the stockpile is in excess of $30B. The affordable solution is to utilize our new modern munitions in such a way as to allow an early transition to the standard stockpile. This solution envisions massive applications of modern munitions during the early days of a conventional conflict. These munitions would be targeted against those enemy targets that pose the greatest threat to the survivability of our delivery systems and maneuver units. By effectively drawing down on these enemy assets, we should be able to transition to employment of the standard stockpile. Figure IV-12 graphically depicts this concept.

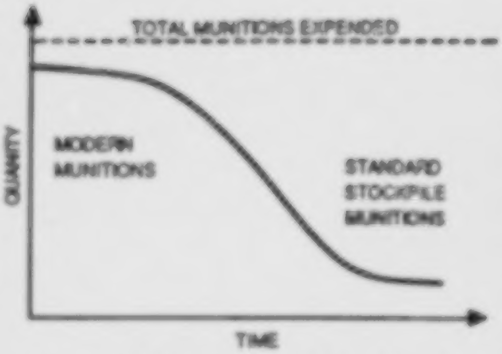


Figure IV-12. Effective Utilization of Munitions Stockpile

The Deputy Secretary directed the formation of the Munitions Council chaired by the USDRE, and we have established the Office of Munitions. The objective in both cases is to focus the munitions efforts of the Military Departments with the near term goal of improving the mix of conventional munitions available to our operational commands. A noteworthy accomplishment of the Munitions Council included a significant increase in the Services' procurement accounts. The majority of these funds were directed toward increased inventories of precision guided munitions such as the HELLFIRE, TOW 2, and Chaparral. In this regard, the Defense Guidance has been amended to better focus on U.S. warfighting capability. The thrust is now one of "Win Early" rather than sustainment alone with our stockpiles.

A recent DSB Task Force, charged with examining the acquisition process for conventional munitions, concluded that the munitions acquisition process can be materially improved and that larger inventories of modern munitions can greatly improve our warfighting capability. The Task Force recommended specific steps to improve the acquisition process. Among these are that management oversight should be based on: stockpile and target oriented master plans; an improved, matched set of analytical models to support program decisions at all stages; a strong Munitions Council with a supporting staff in the Office of Munitions and, means to independently assess munition producibility throughout development. Also, the full-scale development process should be tailored to the special needs of high-technology, high-quantity requirements, and better feasibility demonstrations, long-life evolutionary programs with regularized product improvement plans, and more emphasis on competition and producibility. Our technical base, financial resources, organization, and personnel need strengthening. Conventional munitions technical base funding must be improved--with particular attention to 6.3A feasibilty demonstration programs.

As a result of congressional guidance, a coordinated Anti-Armor Munitions Master Plan has been prepared. This plan is updated annually to help us better manage this important class of munitions. It is our intention to develop a number of target oriented master plans under the umbrella of an overall Conventional Munitions Master Plan. These plans will be used as a means to guide our conventional munitions thrust. The plans will also assist us in articulating this thrust to the Congress.

## MOBILITY

Department of Defense mobility capabilities continue to improve to meet our worldwide commitments. The primary mobility mission is to deliver combat and support forces in a timely manner as close as praticable to intended areas of operation and then sustain these forces with resupply. Timely deployments can deter and defend against Soviet bloc aggression in critical theaters such as Southwest Asia, NATO, and Korea. For most potential areas of conflict, the U.S. has the disadvantage, vis-a-vis the bloc, of much greater distances to deliver and resupply forces; this constitutes the driving factor in designing our mobility assets (airlift, sealift, prepositioning, and supporting elements). Soviet airlift and sealift continue to expand for potential operations in more remote theaters. A prime example is the new Condor AN-124 transport (sometimes called a "C-5 ski" due to its resemblance) and the continued expansion of Soviet sealift. Table IV-8 compares some current U.S. and Soviet mobility modernization efforts. Progress continues to be made in quantifying our mobility needs--e.g., the completed Ready Reserve Force / Container-Mod Ship Sizing and DoD Sealift Tanker studies and the ongoing Worldwide Intratheater Mobility, Operational Support Airlift Wartime Requirements, and Material Handling Equipment studies.

In airlift, we are in final phases of procuring additional C-5Bs, KC-10As (which also provide air refueling capability), and Civil Reserve Air Fleet enhancement. The cornerstone of our airlift moderrization effort is the C-17A. Full-Scale engineering development was approved in 1985, extensive wind tunnel testing of scale models, full-scale ground tests of the turbofan engine, and comprehensive loading and compatiblity demonstrations with Army equipment/personnel have been conducted. First flight is scheduled in FY 1990 with initial operational capability planned for FY 1992. The C-17A, while providing the final increment in achieving our long-term intertheater airlift goal, will also have the flexibility to augment the C-130 tactical airlift fleet, providing a first-ever intratheater outsize capability.

**Table IV-8. U.S./USSR Mobility Modernization Programs**

| U.S. | | USSR | |
|---|---|---|---|
| **Mission Area/ System** | **Qualitative Trends** | **Mission Area/ System** | **Qualitative Trends** |
| KC-135 Tanker Conversions | • Improved fuel offload | IL-76 (Candid) Tanker | • Improved in-flight refueling, comparable to unconverted KC-135As |
| KC-10A Tanker/ Transport | • Very high fuel offload<br>• Can refuel and carry maintenance equipment for deploying fighters | | |
| C-5B Transport | • Expanded force projection<br>• Outsized cargo capability | AN-124 (Condor) Transport | • Somewhat larger but generally comparable to C-5 |
| | | AN-72 (Coaler) Transport | • Configuration similar to much larger U.S. YC-14 Short Take-off and Landing (STOL) transport |
| Fast Sealift Ship Conversions | • Very fast/very large roll-off ships for rapid loading/ transit/unloading | Roll-on/Roll-off ships | • Moderate to fast ships for rapid loading/unloading |

Demonstrations have been conducted to determine the feasibility of increased C-5 performance in the areas of ground backing, heavier takeoff gross weight, and heavier in-flight gross weights. Detailed demonstration data are being analyzed to define any increased capability for the C-5 and the limits of conditions under which they may be used. The V-22 Osprey program (previously JVX) is approaching Full Scale Development. First flight is scheduled for February 1988 to meet the multi-mission role of amphibious assault for the Marine Corps, combat search and rescue to the Navy, special operations for the Air Force, and assault support for the Army. First delivery is for the Marine Corps in 1991.

In sealift, our program for fast sealift ships (previously SL-7) will be completed in 1986. Programs for hospital and Marine Corps aviation logistic support ships and expansion of the Ready Reserve Force continue. Our Merchant Ship Naval Auxiliary RDT&E program is investigating ways to provide merchant ships with capabilities that make them militarily-useful in a crisis that requires increased surge sealift. The new Civil Reserve Auxilliary Fleet Ships (CRAFTS) program will provide military enhancements to newly built commercial sealift.

In prepositioning, the maritime prepositioning ship program will be completed in 1986. Army and Air Force prepositioning in Europe and Southwest Asia, and Marine Corps prepositioning in Norway continues.

In the critical area of cargo offload and discharge system (especially for over the beach operations), acquisition of a variety of equipment (e.g., crane ships, causeway systems and roll-on/roll-off discharge platforms) continues. Our RDT&E program is investigating the development of new and advanced systems--as well as the use of existing commercial systems--that will accommodate the use of modern commerical ships for transfer of cargoes off-shore to the beach. A heavy lift air cushion vehicle is under development by the Army for the ship-to-shore transport of outsize cargo, heavy lift equipment, vehicles, and containers. This vehicle, currently designated Lighter, Amphibian, Heavy Lift (LAMP-H), has a planned IOC in the early 1990's.

In airdrop, development continues on improving the capability (weight, altitude, speed, and accuracy) of delivering personnel and cargo for critical missions. C-17A cargo/troop compartment mockup tests have demonstrated its design for airdrop.

Considerable effort is being made in improving the command, control, and communications ($C^3$) that support mobility forces. The Joint Deployment System (JDS) development has produced a baseline that satisfies most of the information required by the Joint Deployment Community. Post-baseline enhancements and interface with Service unique systems are currently being addressed. The functions of the JDS will be incorporated into the Joint Operations Planning and Execution System with an IOC of FY 1990. The Transportation Coordinators' Automated Information for Movements System is being developed to provide source data to support deployment and the generation of timely and accurate movement information. Each military Service will establish the capability at unit bases with an IOC of FY 1990. Provision of improved sealift communications for merchant ships continues. For airlift, $C^3$ development continues in order to provide capability to rapidly and accurately exchange vital information between the Military Airlift Command ground elements and the aircraft. For secure, jam-resistant communications, a high frequency interoperability standard is being incorporated as part of the development to upgrade aircraft.

## CHEMICAL WARFARE DETERRENCE

### Goals

We must ensure that chemical weapons are never used against either the men and women of our Armed Forces or those of our allies.

We are therefore committed to a goal of re-establishing a credible military deterrent to chemical warfare. The following elements constitute our deterrent program:

- Obtaining a retaliatory capability in the form of safe, binary weapons.

- Providing our armed forces with the best chemical defensive equipment and training to permit sustained operations in a chemical/biological environment with special emphasis on reducing the difficult problems associated with working in that hostile environment.

- Expanding the ability of U.S. forces to treat casualties associated with nuclear, biological, chemical, and conventional weapons.

We are also developing an effective destruction program to rid ourselves of our existing lethal unitary weapons.

In accordance with our international treaty obligations, we will not possess or employ biological or toxin weapons, and we will use chemical weapons only in retaliation to the use of those weapons on our forces or those of our allies. We seek to eliminate the threat of chemical and biological warfare by achieving a complete and verifiable ban on chemical weapons and by seeking to strengthen existing agreements through verification and compliance provisions.

## Major Achievements

With OSD acting as executive agency, the President's Chemical Warfare Review Commission concluded its review of the entire chemical warfare program and reported its findings in June of 1985. The major findings and recommendations centered on the adequacy of our current chemical munitions stockpile, the binary chemical modernization program and its influence on arms control, and the effectiveness of our defensive equipment measures.

The Commission concluded that our existing stockpile of lethal chemical munitions was not an adequate deterrent to the Soviet use of chemicals against us, citing the fact that the stockpile did not contain the kind of munitions required on the modern battlefield and the remaining munitions were old, deteriorating, and of little military value. It further recommended the accelerated destruction of this aging stockpile.

The Review Commission highlighted the value of our binary modernization effort as the portion of our program that would have the greatest influence toward achieving an effective arms control agreement while at the same time providing a credible deterrent to the use of chemicals in any conflict. In this regard, we are ready to produce the 155mm binary artillery shell and are vigorously continuing the development of the BIGEYE chemical bomb. BIGEYE development testing was completed in mid FY 1985 and the first phase of operational testing will be completed in early FY 1986. The second phase of operational evaluation is scheduled for late FY 1986 to be completed early in FY 1987. Longer range development programs are addressing some stand-off delivery systems.

The Commission noted that defensive measures alone were not sufficient to deter chemical warfare. However, they also noted the value of protective equipment to save lives and therefore preserve military capability.

To this end, our chemical defense technology efforts continue to expand and achieve substantial progress toward meeting the needs of our combat forces. Cooperative programs with universities, industry, and our allies are providing new detection and warning devices with improved sensitivities and portability. Advances in biotechnology have made possible protection breakthroughs in toxin detection mechanisms, prophylaxis, and casualty treatment. Decontamination systems are being fielded to enhance readiness and survivable collective protection systems are being procured to increase our sustainability in a chemical environment.

### Current Objectives

The FY 1987 chemical warfare deterrence program allocates our budget in approximately the same proportion as previous years. Over 75% is allocated for defensive equipment needs. About 10% of the program funds continue to support our program to destroy the existing munitions stockpile. The remainder of the budget is for all of the areas relating to achieving a credible and effective retaliatory capability.

The Biological Weapons Convention comes up for review this year. In preparation for this review, we are assessing the national security impact of known and suspected Soviet agent capabilities.

# V. COMMAND, CONTROL, COMMUNICATIONS AND INTELLIGENCE ($C^3I$)

## $C^3I$ GOALS/OBJECTIVES

Our national security policy of deterrence of war through the defensive use of military power relies on the ability to quickly react after an enemy has taken the first initiative. In order to carry out this policy, our $C^3I$ systems must support command decision making with timely and accurate information and provide our commanders, at all echelons, the means to effectively employ their forces. Furthermore, we must be able to sustain these capabilities during both peacetime and periods of crisis.

Within the $C^3I$ mission area, the primary goal is to provide the secure, survivable, endurable, and interoperable $C^3I$ systems needed to maximize the performance of our forces and weapons systems. In pursuit of this goal, our overriding objectives are to: (l) build a more secure, survivable and enduring $C^3I$ system capable of supporting the forces through any level of conflict; (2) correct emerging deficiencies in response to new threats and new mission needs; (3) improve existing $C^3I$ assets by taking advantage of new technologies; (4) enhance the readiness of our strategic and tactical forces with upgrades in the areas of mobility, interoperability and sustainability; and, (5) strengthen our backbone multi-purpose communications networks. These objectives not only cover the development and acquisition of $C^3I$ systems needed to carry out strategic and conventional missions in conjunction with our allies, but also the development of effective electronic combat and $C^3$ countermeasure systems for disrupting the enemy's $C^3I$ capabilities.

## MAJOR ACHIEVEMENTS

### Strategic and Non-Strategic Nuclear Forces

The $C^3I$ systems supporting the strategic and non-strategic nuclear forces are a critical element of deterrence. Considerable progress has been made in developing and acquiring the C$^3$I systems needed for an integrated and effective nuclear force.

In order to improve communications and ensure connectivity between sensor sites, command locations, and nuclear capable forces, we are continuing to improve our strategic ground based, airborne relay, and satellite communications systems. A major objective planned for FY 1986 is the completed installation of the second phase (Thin Line Connectivity Capability) of the Ground Wave Emergency Network (GWEN). The GWEN is a dispersed network of radio relay stations and user terminals designed to provide assured communications connectivity to CONUS based nuclear forces. Communications connectivity with our submarine forces is also being improved, and an associated reduction in their susceptibility to detection is being realized with the implementation of the Extremely Low Frequency (ELF) communications system. The ELF system is expected to be fully operational in FY 1988. Also, fabrication of the prototype Take Charge and Move Out (TACAMO) replacement aircraft (E-6A) for the EC-130 is continuing with the contract award for the first two production aircraft expected in FY 1986. In the area of satellite communications, the Defense Satellite Communications System (DSCS III) and MILSTAR programs are continuing and will represent a significant enhancement in our ability to command and control our forces worldwide.

A number of improvements have been implemented, and further improvement efforts are underway in the attack warning/attack assessment area. We have initiated the procurement of additional PAVE PAWS radars to be operational in 1986 and 1987. In addition, we are currently upgrading the Thule Ballistic Missile Early Warning Stystem (BMEWS) radar and plan to initiate similar upgrades to the Fylingdales BMEWS radar in England during 1986. These upgrades will significantly enhance the quality and detail of missile warning information in the event of a nuclear attack by Intercontinental Ballistic Missiles (ICBMs) and/or Submarine Launched Ballistic Missiles (SLBMs). Also, replacement of the existing Distant Early Warning (DEW) Line, called the North Warning System, will result in a substantially improved capability to detect modern aircraft and cruise missiles across the entire North American boundary. The North Warning System, together with the new Over-the-Horizon Backscatter (OTH-B) radars, will provide complete contiguous surveillance coverage and timely warning of bomber or cruise missile attacks on North America.

We are also continuing to upgrade the capability and survivability of the command centers from which U.S. strategic forces would be directed during nuclear conflict. An example of our progress is the completed delivery of the four E-4B National Emergency Airborne Command Posts (NEACP). Delivery and fielding of NEACP is a considerable step forward in enhancing the survivability of the National Command Authorities (NCA) and, in turn, capacity for providing enduring strategic command and control.

## Theater and Tactical C$^3$

Theater and Tactical C$^3$ focuses on the effective management and use of modern weapons systems on the tactical battlefield. Our efforts address not only service unique systems, but also joint service and allied capabilities.

A significant milestone was reached in our efforts to promote interoperability between the U.S. and our allies. NATO has endorsed an agreement on the operating parameters to be used in the NATO Identification System (NIS). The NIS is a NATO interoperable system for reliably distinguishing aircraft as friend or foe. Work is proceeding on defining the technical parameters of the system, and a test flight of the system is scheduled for 1987.

Major advances and milestones were also reached last year in the research, development and acquisition of specific equipment for improving theater and tactical C$^3$ capabilities.

The Joint Tactical Information Distribution System (JTIDS) program is designed to provide a highly jam resistant, secure digital information system for use in a tactical combat environment. Delivery of the JTIDS Class I Ground Terminal is on-going, and a successful flight test of the JTIDS Class II terminal on an F-15 aircraft was conducted this past year.

Another joint effort, the Air Force and Marine Corps Modular Control Equipment/Tactical Air Operations Control (MCE/TAOC) program, will replace obsolete tactical air surveillance and control units. MCE/TAOC is undergoing field testing and production is scheduled to begin by late FY 1986.

The High Frequency (HF) Anti-Jam program is developing anti-jam HF communications systems to meet tactical support and strategic connectivity needs. Developmental testing has been conducted and a full-scale engineering development contract is planned for award during FY 1986.

With the delivery of the last Airborne Warning and Control System (AWACS) E-3A to NATO during 1985, the full 18 aircraft complement is now operational in the European theater. These aircraft have substantially increased the survivable surveillance and command and control capabilities of the NATO forces.

An example of our efforts to utilize commercial technology for military use and thereby reduce costs and shorten acquisition time is the Mobile Subscriber Equipment program. Procurement of off-the-shelf equipment for the program has begun. This program should allow the fielding of hardware with significantly less cost and less than one-third of the standard development time.

## Defense-Wide Communications and Information Systems

Defense-Wide Communications and Information Systems provide a broad range of day-to-day and crisis communications and information for the management of both conventional and nuclear forces.

Major advances have been made in the Defense Switched Network (DSN), DoD's next generation long-distance telephone service, and the Defense Data Network (DDN), a survivable and secure data communications network. Acquisition of commercially available technology is beginning, and initial operation of Phase I of the DSN in some geographical areas is planned for FY 1986. In support of critical ADP communications requirements, the DDN will provide increased communications capacity and strengthened access controls. Network components have been installed in the Pacific Theater and the European Movement Information Network has been integrated into the Military Network (MILNET).

Modernization of the Worldwide Military Command and Control System (WWMCCS) Automated Data Processing (ADP) capabilities is being conducted under the WWMCCS Information System (WIS) program. Major contracts for the development of hardware and software have been awarded, and deployment of Block A hardware and software is scheduled for FY 1988.

Other ADP modernization efforts include upgrades to ADP systems at the NORAD-Cheyenne Mountain Complex needed to satisfy $C^3I$ requirements for space operations and replacement of the Command Center Processing and Display System. Competitive design contracts for the Command Center Processing and Display System-Replacement (CCPDS-R) were awarded in FY 1985. When completed, the CCPDS-R will provide improved display of warning information for the nation into the year 2000.

Significant progress has also been made in improving and expanding the application of security equipment and techniques for computer and communications systems. In support of the continued dynamic growth of ADP operations in government, a computer security criteria was developed by the Computer Security Center of the National Security Agency, and research and development efforts have been focused on expanding new technologies which ensure proper access and protect sensitive data bases. A major initiative within the more mature Communications Security (COMSEC) technology is the development and acquisition of low cost, convenient and secure telephones for use throughout the Federal Government and the contractor communities who conduct classified or sensitive matters with the government. Other development efforts of particular note include initiatives to eliminate hard copy and paper based systems and initiatives to increase the embedding of COMSEC in host systems, with the added benefits of space and cost savings.

Global Positioning System (GPS) is a major project for improved worldwide combat enhancements through highly accurate positioning and timing capabilities. Satellite production is continuing with the launch of the first operational satellite scheduled for 1987. Deployment of an 18 satellite constellation is scheduled for 1989, and full deployment of operational user equipment is planned for completion by the late 1990's. Full operational deployment of the GPS will provide much needed capabilities that are unavailable under any existing single system or combination of systems.

## Electronic Combat and $C^3$ Countermeasures

Electronic combat and $C^3$ countermeasures focus on preventing the hostile use of the electromagnetic spectrum, protecting friendly $C^3I$ systems, and disrupting an adversary's $C^3$ systems.

An important first step toward achieving an improved electronic combat and countermeasures acquisition and investment strategy was realized in FY 1985 with the publication of the DoD Electronic Warfare Plan. This plan provides the framework for future electronic combat techniques and equipment development from planning to employment.

Additional major strides during FY 1985 include the initiation of Development Test and Evaluation (DT&E) of the joint Air Force/Navy Airborne Self-Protection Jammer (ASPJ) for our front-line fighter/attack aircraft. Another joint Air Force/Navy program, the Integrated Electronic Warfare System (INEWS)/Integrated Communications Navigation and Identification Avionics (ICNIA), has been established to develop integrated electronic combat capabilities and avionics for new design aircraft.

Also during the past year, the Air Force completed initial development and deployment of the COMPASS CALL aircraft, an airborne jamming system designed to degrade an enemy's $C^3$ capability.

## Defense-Wide Intelligence

As the need for intelligence support has become more vital in meeting our worldwide commitments, we must ensure the compatibility, interoperability, and survivability of our intelligence systems. To this end, significant advances in developing integrated intelligence architectures were accomplished during FY 1985 under the Theater Intelligence Architecture Program, Intelligence Communications Architecture Program, and the Imagery Acquisition and Management Plan. Aggressive pursuit of these and related planning activities has improved the focus and effectiveness of the intelligence program.

To support the intelligence capabilities of the theater commands, TR-1 aircraft are being fielded. These aircraft are being acquired both within budget and ahead of schedule. As a related effort, fielding of the ASARS II, an advanced synthetic aperture radar system for the TR-1 aircraft, began in FY 1985 in the European Theater. In the coming years, additional advanced collection platforms and sensors will be developed to give field commanders the ability to look deeper into enemy territory with greater accuracy.

In like manner, we are improving our ability to process and exploit collected intelligence in a timely manner. Under the Joint Tactical Fusion Program (JTFP), we are developing an objective automated fusion capability for the Army and the Air Force to be fielded beginning in the late 1980s. Today, interim systems that provide lessons learned for JTFP development are located with selected units. As an example, the Limited Operational Capability Europe is supporting operational requirements for the European theater. Further, it is being used in a two year test under NATO's Battlefield Information Collection and Exploitation Systems activity (part of the Secretary of Defense's Emerging Technologies initiative with NATO) to develop interface requirements for supporting coalition warfare through the sharing of tactical intelligence with our allies. Using this near-term/mid-term approach, we are evolving an effective capability to support the commanders' need for timely, accurate information.

In addition to these and other programs aimed at placing equipment in the field for increased intelligence capabilities, we are continuing to stress improved intelligence training. Intelligence training systems are being enhanced and investments in foreign language programs for personnel associated with intelligence activities are continuing.

## Special Operations

$C^3I$ special operations efforts focus on the coordination and oversight of research and development in support of special operations and counterterrorism activities. Significant accomplishments achieved in Special Operations Forces (SOF) mission areas include: the procurement of additional Combat Talon II infiltration/exfiltration aircraft; upgrading additional air refuelable helicopters with adverse weather, night and terrain following capabilities; and increased aircraft readiness through a robust spare parts procurement program. In addition, new assault craft are being purchased for Naval Special Warfare units and the capabilities of swimmer delivery vehicles are being improved. We are also continuing to develop new SOF equipment such as remotely piloted vehicles, special avionics, improved exfiltration systems, underwater breathing devices, and lightweight, secure radios. Future plans include developing new technology to reduce the weight and volume that SOF teams must carry.

## LOOKING TO THE FUTURE

As we continue to move forward with the $C^3I$ improvement initiatives started under the President's Strategic Modernization Program, it is important that emphasis be placed on maintaining a balance between existing and future weapons systems and their supporting $C^3I$ systems. Such a balance is critical in attaining affordable force management capabilities and essential to providing the rapid response and connectivity necessary for the fulfillment of our deterrence strategy. To achieve this balance we must:

- Ensure that our C$^3$I systems are as survivable and endurable as the weapons systems they support.

- Intensify the life-cycle management of C$^3$I through the support of existing management improvements such as the Joint Tactical C$^3$ Agency and adoption of new initiatives aimed at increasing both the performance and cost-effectiveness of C$^3$I assets.

- Provide the overall systems architectures and plans necessary to direct the evolution of C$^3$I capabilities.

- Continue the parallel development and acquisition of C$^3$I and associated weapons systems in order to assure the timely and effective utilization of these systems.

# VI. DEFENSE WIDE INITIATIVES

## SCIENCE AND TECHNOLOGY

The effectiveness of modern military forces in a large measure is determined by the quality and quantity of materiel and support provided to the Armed Services. In order to satisfy the need for capable, reliable and affordable equipment, the DoD maintains a strong Science and Technology (S&T) program which is the foundation of our RDT&E program. Thus the S&T program, through the technological progress it promotes, increases the deterrent value of U.S. forces and acts as a hedge against Soviet technological surprise.

A principal objective of the S&T program is to maintain a technological lead over potential adversaries. The maintenance of this lead is becoming increasingly critical as the Soviets field higher quality equipment for their forces. Therefore, we must ensure not only that our military technological base is viable and strong but also that our national technology infrastructure is second to none. The combined efforts of industry, universities and government laboratories are essential to the maintenance of a strong military technology posture.

The S&T program is managed by the Services and Defense Agencies. It covers a wide range of technologies and projects of importance to the military. These programs cannot be covered in detail by this statement; however, selected S&T activities will be highlighted in the following paragraphs.

### Integrated Circuit Technology

The Very High Speed Integrated Circuits (VHSIC) program increases the United States' lead in integrated circuit technology. Most of the VHSIC 1.25 micrometer integrated circuits are functional with thousands of sample chips available for weapon system insertion. In addition, a number of brassboards that provide signal processing capabilities at the leading edge of technology are fully operational. Second generation VHSIC chip development is underway and devices are being delivered for DoD testing with 0.5 micrometer minimum feature sizes. The second generation VHSIC chips will produce another 50-100 fold increase in signal processing capability.

A new program has been initiated that is oriented towards providing major improvements in the sensor electronics, the 'eyes and ears' of electronic systems. This effort will focus on monolithic gallium arsenide integrated circuit technology and will emphasize analog functions for microwave and millimeter wave military applications. The Microwave/Millimeter Wave Monolithic Integrated Circuits (MIMIC) program is application oriented and calls for rapid technology insertion into existing and future military systems. MIMIC will provide advanced capabilities in analog circuitry for affordable applications in aircraft, missiles, surveillance and other military systems.

## Basic Research

The basic research program provides fundamental understanding and concepts required for long-term technical superiority. Examples of the research accomplishments from this program are the advanced composite materials analysis techniques formulated by Drexel University and the laser-tomographic flow field visualization technology developed by the University of Michigan. These results will impact military structural and airframe design and analysis.

Major efforts are being made to improve the coordination with and the capabilities of the universities performing DoD research. In September of this year, the President established a policy on the transfer of scientific, technical and engineering information. This policy enhances significantly DoD's relations with universities and industry by establishing that, to the extent possible, the dissemination of results from federally funded fundamental research will be unrestricted. In addition, the University Research Instrumentation Program enhances the effectiveness of university programs and the University Research Initiative underscores our commitment to accelerate the process of strengthening university research in defense related technologies. These actions will enhance the basic research program of the Department.

## Strategic Computing

The Defense Advanced Research Projects Agency (DARPA) is undertaking technology programs in artificial intelligence, multi-processor system architecture and optical and micro-electronic devices with the objective of developing a class of "intelligent" systems that will provide additional dimensions to weapons and equipment. Such smart computers will be used to demonstrate important applications via the autonomous land vehicle, airplane pilot's associate and battle management projects. Follow-on systems employing this technology, with suitable sensors, will be able to help humans reach reliable conclusions in intelligence assimilation, target discrimination, target assignment and other difficult tasks faster and more accurately than with present conventional computing systems. In addition to improving the functional performance of future defense systems, the strategic computing program promises very favorable return-on-investment because of its innovative character and potentially widespread application throughout the Services and Defense Agencies.

## Aircraft Propulsion Technology

Aircraft propulsion continues to be a high-payoff technology for DoD. In recognition of the long-term prospects, an innovative integrated exploratory and advanced technology development program aimed at increasing the capability of aircraft turbine engines by 100% by the turn of the century is being formulated. The major feature of this program is an integrated materials/propulsion technology effort to permit higher payoff/higher risk approaches in exploratory development. The program will be fully defined this year, and will lead to large increases in aircraft capability. For example, it is expected that a sustained Mach 3 plus capability in an F-15 size aircraft and intercontinental ranges in an air launched cruise missile size vehicle will be possible. Conducting a vigorous aircraft propulsion technology program in order to both maintain our military posture and national preeminence is an important aspect of the DoD S&T program.

## Advanced Aircraft Technology

The aircraft technology program continues to focus on the integration of aircraft functions to provide increased operational capability and enhanced survivability. The current emphasis is on the integration of flight controls with propulsion controls featuring thrust vectoring/thrust reversing exhaust nozzles for short takeoff and landing (STOL) and increased maneuver performance. The work is being pursued on a specially modified F-15 aircraft which is projected to takeoff and land in 1500 feet. The first flight of this aircraft is scheduled for FY 1987 to demonstrate technologies which are applicable to the Advanced Tactical Fighter or can be retrofitted to upgrade existing fighter aircraft. Increasing the combat capabilities of future military aircraft is an essential part of our modernization program.

## Armor and Anti-Armor

The protection of our forces with armor capable of withstanding hostile firepower and also providing them with offensive options for defeating hostile armor forces continues to be a major factor in the seesaw exchange of force and counterforce. To improve our posture in the armor arena, DARPA has initiated a broad research and development program which includes fundamental mechanisms and phenomenology, mathematical models, improved measurement techniques, and development of advanced armor materials. In developing better means for defeating armor, recent advances in millimeter and infrared sensors and the hypervelocity electromagnetic gun programs will be exploited. The objective is to demonstrate a new family of low cost terminal homing munitions compatible with both conventional and advanced launchers. The need to establish and maintain a United States advantage in this area is critical to future battlefield outcomes. These efforts will be a significant step toward achieving this objective.

## Computers and Software

The DoD Software Initiative has made major strides toward its goal of improving our capability to develop reliable, cost effective software for mission critical computer systems. Ada, the Department's standard programming language, is winning wide acceptance and many compilers have been validated. In addition to use by U.S. forces, Ada has been adopted as NATO's standard programming language and is one of two languages authorized for use in the United Kingdom's defense systems. The Software Engineering Institute is now operational and is working on techniques to accelerate transition of software technologies from the laboratory into use in mission software. The Software Technology for Adaptable, Reliable Systems (STARS) Program has made progress toward developing approaches for the development of software with reduced cost, higher reliability, greater reuseability and increased effectiveness. Technological progress is necessary in the software area because of the increasingly important role it plays in the performance of most modern weapon systems and equipment.

## Training Technology

As training of both active and reserve forces is a major peacetime activity, it is important that we do it well and at acceptable cost. Technology advances in computer software, electroluminescent displays, voice synthesis and recognition and computer generated imagery make possible a range of options for increasing training effectiveness. For the maintenance technician, a portable training and job aid device will be demonstrated. This briefcase size device will weigh less than 30 pounds and could replace, if needed, approximately 25 linear feet of manuals and instructional material. In addition, the development of lower cost visual systems will be emphasized so that real world visual scenes that provide better training can be used in more simulators. Realistic and affordable visual scenes are one of the key component of a wide range of training simulators. Training is a major DoD expense and we will continue to apply technology to make training better and make it more cost effective.

## Materials and Structures

During FY 1987, the materials and structures technology program will emphasize the survivability of aircraft and missile structures against potential enemy directed energy weapons. While the principal effort will address the laser threat, the program will also include protective concepts for military equipment subjected to high power microwaves and particle beams. These efforts will be directed towards evolving innovative material and structure hardening techniques using unique combinations and structural arrangements of coated metal-matrix and carbon-carbon composite materials. Important advances already have been made to demonstrate the survivability characteristics of metal-matrix composites against possible threats. We will continue to emphasize the development of other materials and structures that will withstand the rigors of directed energy devices.

## Laser Technology

Significant progress has been made in laser technology developments. Work is being undertaken on technologies to improve the efficiency and utility of medium power lasers that could have near term military applications. Our goal is to provide inexpensive and reliable lasers that improve the combat capability of our soldiers, armor and combat aircraft. Lasers have significant military potential and it is important that a balanced program in offensive weapons, countermeasures to hostile lasers and protection of our personnel be conducted in order to achieve objectives of this technology program.

## Hypersonic Technology Program

The DoD has initiated joint planning with NASA for a National Aerospace Plane research program. The new activity is based on hypersonic research carried out by DARPA and NASA for a number of years. The concept centers on a hydrogen fueled aircraft capable of horizontal takeoff and landing, operating at speeds between Mach 12 and Mach 25 at altitudes between 100,000 and 350,000 feet. The approach involves the maturation of key technologies including propulsion module development and airframe design of an experimental flight research vehicle. Successful demonstration of this concept could lead to expanded capabilities in global reconnaissance, improvements in long range air defense, reduced space transportation costs and high speed global transportation.

## Nuclear Effects Technology

The Defense Nuclear Agency ensures that strategic and theater forces are provided the technology to operate in a nuclear environment as well as providing information that will permit prediction of destructive thresholds of enemy systems. In addition, underground nuclear tests are conducted that provide design information to reduce uncertainties associated with safety margins, risks and costs.

The FY 1987 program includes a number of important research and development events. Two underground tests are planned that will provide survivability requirements for TRIDENT II and other critical systems. Work will continue on the development of electromagnetic pulse standards and specifications to protect equipment against intense current surges and electromagnetic fields. A research satellite will be launched to gather radio scintillation and other atmospheric data required to predict performance of command, control and communications systems. In addition, research and development will continue on radiation hardening of emerging microelectronic components that will be capable of operation in tactical and space environments.

The survival and operation of our forces are key considerations of the Unified and Specified commands. Towards this end, the understanding of nuclear phenomena, the design of equipment and facilities to withstand nuclear effects, the physical protection of nuclear weapons and storage sites, and the hardening of electronics are being examined. These fundamentals are essential for effective military operation, and are the focus of the nuclear effects technology programs.

## TEST AND EVALUATION (T&E)

Test and Evaluation management within the Department of Defense has continued to receive considerable review and refinement within the past year. The Test and Evaluation Policy Directive -- DoDD 5000.3 -- is being reissued to define more stringent management policies in line with the Department's emphasis on operational test and evaluation as well as to place more emphasis on up-front development and qualification testing. Initiatives to enhance the overall quality of Test and Evaluation methodology and resources in the Department and to develop advanced threat simulators have also moved forward. The Services' adoption of several new NATO-produced systems tested under the Foreign Weapons Evaluation Program will contribute to other initiatives underway to induce more allied participation and support of the NATO Alliance.

### Enhancing Our Defense Systems Test Capabilities

The tri-Service development program established to develop threat simulators has created a data base for use in simulating the latest, most capable threat air defense systems. An integrated program is consolidating scientific and technical intelligence, surrogate testing, and simulator development. Inventories and shortfalls have been cataloged and requirements for additional threat simulators are being identified.

A Supersonic Low-Altitude Aerial Target is being developed to replicate the high speed, low altitude dash threat of anti-ship missiles by late 1989. A new subscale subsonic target will also replace older, costlier systems and provide testing for counterair systems by 1989. A new Army helicopter aerial target, needed to test battlefield air defense systems, is now under development and is expected to be fielded by 1987.

A two volume Software Test and Evaluation Manual has been issued for use throughout the Department of Defense and Defense industry. This is one of several ongoing efforts aimed at improving the test and evaluation of major systems through improved acquisition management and risk reduction procedures. The manual contains important implementing tools which will be applied in support of existing and planned policy for the test and evaluation of software intensive systems.

Modernization of our test facilities and resources is continuing with such programs as the Navy's Extended Area Test System at the Pacific Missile Test Center and the Air Force's Aeropropulsion Systems Test Facility (ASTF) which will reach operational capability in 1986. The foundation for a new generation of range Time Space Position Instrumentation (TSPI) systems was established when the tri-Service Global Positioning System/TSPI (GPS/TSPI) program entered full-scale development in 1986.

## Joint Test and Evaluation (JT&E) Programs

Five ongoing tests will examine the capability of developmental and deployed systems to perform their intended missions in a joint environment in FY86. These tests include evaluation of Command, Control, and Communications Countermeasures; Identification of Friend, Foe or Neutral Systems; Forward Area Air Defense Capabilities; Electro-Optical Guided Weapon Countermeasures and Counter-countermeasures and live munitions effects on foreign and domestic armor and aircraft.

## International T&E Initiatives

Under the provisions of an international T&E agreement concluded with Canada, the Air Force successfully completed a captive carry flight and two free flight tests over Canada of the Air Launched Cruise missile during the winter of 1985. Operational test flights will continue this winter. The Canadian-U.S. agreement is affording the Department a unique opportunity to test weapons systems in realistic battlefield conditions and geophysical environments replicating those in Europe and Eurasia. Cooperative agreements are being formulated with France, the United Kingdom, Israel, and the Peoples' Republic of China to assist them in the long term improvement and modernization of their testing capabilities and to create the standards where in we and they can accept test data on a bilateral basis.

The Foreign Weapons Evaluation Program has resulted in 25 items of equipment being selected for U.S. inventory with a procurement value of over two billion dollars. By capitalizing on the research and development efforts of our allies, we have been able to obtain nearly $40 of procurement value for every test dollar invested compared to a return of $3.20 in procurement value for every RDT&E dollar invested in domestic programs. This successful program with its added features of increased interoperability and standardization with our allies, continues to enhance the international cooperation and provides an added incentive to our Allies to contribute more to our mutual defense.

## Test and Evaluation Oversight

In addition to these initiatives, the Deputy Under Secretary for Test and Evaluation and the Director, Operational Test and Evaluation maintain continuous oversight on Service testing of over 150 acquisition programs. Top-level supervision of testing throughout the life-cycle of each major program is provided with the intent of ensuring effective, realistic testing; reducing redundancy in testing and obtaining the maximum use of critical test and evaluation resources. Approval authority is maintained over the Test and Evaluation Master Plans for major systems and tests in process are monitored in order to provide a comprehensive assessment of all test results to support major program decisions. This oversight has resulted in enhanced efficiency in the use of critical test resources, focused increased attention to the correction of critical system deficiencies, and resulted in a sound basis for decision.

## WEAPON SUPPORT AND LOGISTICS R&D

Research and Development to reduce weapon support requirements and improve logistics operations is increasing as a result of the setting aside of FY86 funds to increase activities in these areas. Major efforts now underway include improvement of maintenance diagnostics capabilities, reliability and maintainability improvements, and Computer Aided Logistic Support (CALS). Diagnostic capabilities improvements are being sought through the development of computer-aided design applications and use of expert system technology to improve troubleshooting. The objectives are to develop very accurate diagnostic tools, (such as built-in test), reduce the size of the external test equipment, and reduce maintenance training and skill level requirements. A number of field demonstrations of improved diagnostics capabilities are planned over the next three years for both new systems (B-1B) and fielded systems (Apache and Blackhawk). Substantial improvements will also be achieved in the reliability and maintainability of equipment for use in future weapon systems through technology programs such as the Air Force "R&M 2000" program. Another high priority objective is to improve the usefulness, quality, and timeliness of logistics technical information, such as engineering drawings and technical manuals, through automation and system integration of DoD and contractor data bases. These technology efforts are crucial to the recent DoD initiative on CALS, which seeks to transition from our current paper-intensive logistics processes to a largely automated mode of operation for weapon systems entering production in 1990 and beyond.

## SPACE

The Soviet space program is large, dynamic, and expanding. It now encompasses almost 100 launches per year, with over 140 satellites operational at any one time. Their activities in space indicate that the emphasis in the Soviet program is on military objectives: providing support to their own military forces and developing the ability to deny use of space to enemy military forces. They attach lesser emphasis to the civilian aspects of their program: earth sensing, lunar and planetary exploration, and astronomy. These account for only a fraction of their launches. The size of the Soviet program--which is significantly larger than that of the U.S. and its greater emphasis on military activities is indicated on Figure VI-1.

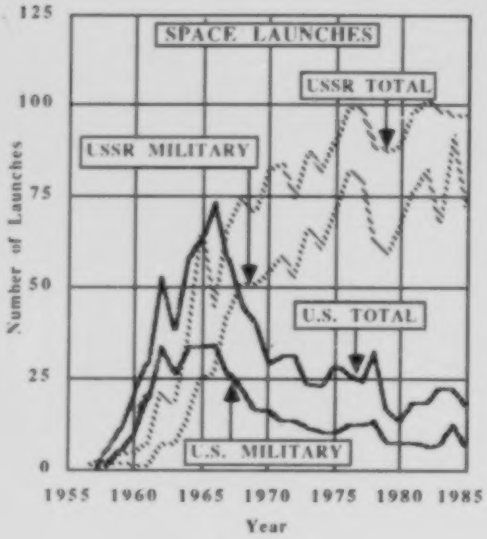


Figure VI-1. U.S. and USSR Space Launches, 1957-1985

The Soviets do not advertise the fact that their space systems, both unmanned and manned, have military applications, nor readily admit that they have developed any purely military space systems.

The U.S. maintains nearly the same number of satellites active in orbit as does the Soviet Union. However, by virtue of longer spacecraft operational lifetimes, it is able to do so with significantly fewer launches. Despite the four times greater launch rate, and total annual payload lifted to orbit, the cost of the Soviet space program is estimated to be only about twice that of the U.S. The lower Soviet unit cost is due both to their use of less sophisticated spacecraft and to their longer launch vehicle and spacecraft production runs. In addition, their relatively high launch rate contributes to the intrinsic robustness and flexibility of the Soviet space launch infrastructure.

The Soviets have three space assembly and launch complexes, located at: Tyuratam, Plesetsk, and Kapustin Yar. Major new launch and support facilities are nearing completion at Tyuratam for a family of new space launch vehicles and reusable spacecraft (see Table VI-1). Operational

**Table VI-1. U.S./USSR Space Modernization Programs**

| U.S. | | USSR | |
|---|---|---|---|
| **System** | **Qualitative Trends** | **System** | **Qualitative Trends** |
| **Space Vehicles** | | | |
| Space Shuttle | • Place DoD satellites in low earth orbit | Space Shuttle | • Reusable space transportation system |
| Centaur Development as Upper Stage | • Provides upper stage to place DoD payloads in high orbit | Heavy-Lift Launch Vehicle | • Space shuttle counterpart, augmentation to Saturn-V class |
| Complementary Expendable Launch Vehicle (CELV) | • Supports assured access to space | Medium-Lift Launch Vehicle | • Supports high launch rates |
| **Payloads** | | | |
| Navy Remote Ocean Sensing System | • Naval oceanographic satellite | GLONASS Navigation Satellite | • Worldwide precision navigation and positioning |
| Defense Satellite Communications System III (DSCSIII) | • Improved jam resistance for command, control and early warning | Satellite Data Relay | • Worldwide near-real-time data transmission |
| Milstar Satellite Communications System | •Assures survivable and enduring wartime communications connectivity | | |
| Navstar Global Positioning System | • Precision all-weather navigational data | | |

capabilities for these new facilities and systems will probably be achieved in the late 1980's to early 1990's. The U.S. Space Transportation System (Space Shuttle) and its launch facilities are comparable developments, now almost fully operational.

The new Soviet heavy lift launch vehicle is estimated to have the capability to lift up to 330,000 pounds to low orbit, far exceeding their prior maximum of 44,000 pounds and in the same class as the discontinued U.S. Saturn. The U.S. Space Transportation System can place 65,000 pounds of payload into low earth orbit.

The Soviets have continued to expand their operational capability in space, as evidenced by their resumption of space station activities, their efforts associated with the development of a new family of launch vehicles, including a shuttle like ours and a small space plane, and increased on-orbit assets. Clearly, their objectives are to expand their warfighting capability utilizing space assets and to integrate the use of these systems with terrestrial forces

Our specific objectives in space are focused on pursuing a vigorous research and development program that will have potential high military payoff, defining methods that address reliability, maintainability, and supportability of our space assets, and providing an assured access to space through the combination of the space shuttle and unmanned launch vehicles.

With regard to unmanned launch vehicles, we have initiated two programs that will significantly support our requirement for assured access to space. The first is the Complementary Expendable Launch Vehicle (CELV) program which will provide a complement to the shuttle for heavy geosynchronous payloads launched from the east coast. The second is the Titan ICBM refurbishment program. These vehicles will support those small payloads going to unique polar orbits from Vandenberg that would otherwise be flown on the shuttle in a less efficient manner.

Speaking of Vandenberg, we have recently activated the shuttle launch facility and are preparing for the first mission. This will be a dedicated DoD mission flying the Teal Ruby and CIRRIS spacecraft. Because of the high media interest in this first Vandenberg flight, we have unclassified the mission. This flight will be the third dedicated DoD shuttle mission. The two previous missions from Kennedy were highly successful and demonstrated that we had corrected the anomaly problem with the Inertial Upper Stage (IUS).

The recent catastrophic loss of the Space Shuttle Challenger may result in possible setbacks to some of our national security space programs including slipping the first Vandenberg launch. Until we know for sure the cause of the accident and the resulting time to correct the problem, the actual impacts cannot be totally ascertained. Nevertheless, the Secretary of Defense has directed an assessment to address the impacts to current and planned programs and the capabilities and options available to launch those space systems vital to our national interests. The results of this assessment will be used to determine if any programmatic and/or policy decisions are warranted.

One specific program that we are investigating very closely deals with the work that DARPA has performed on hypersonic technology. This work appears to have significant potential for reducing space transportation costs. Additionally, the many spin-off applications of this technology will aid in maintaining U.S. leadership in aeronautics and the commercial use of space.

Space related research and technology continues to be an important part of our overall research and development effort. We have recently initiated a study, together with NASA, to define the next generation space transportation system. What is unique about this effort is that we are looking at the whole picture of space transportation, not just the launch vehicles, but the ground and on-orbit operations as well. Our objective is to develop a plan that will provide an investment and technology development strategy to support future national security, civil, and commercial space transportation needs beyond 1995.

## INTERNATIONAL ARMAMENTS COOPERATION

### Goals

The basic goal of our international armaments cooperation program is to develop, field and support--through equitable burden-sharing--the most effective and interoperable conventional military equipment for both U.S. and friendly nations forces. This requires collaborative programs based on the principle of equity--sharing both risks and benefits.

### Specific Objectives

A credible collective non-nuclear forces capability within NATO will require substantial investment by the U.S. and Allied governments. Armaments cooperation is a key incentive to economically achieve these investments. Thus, our objective is to create an environment which fosters maximum use of combined technological and industrial capabilities by working within the NATO Conference of National Armaments Directors (CNAD), through individual bilateral and mutilateral agreements for specific development and production programs, and by placing emphasis on utilizing the broad industrial infrastructure for cooperation which exists in international industry-to-industry relationships.

The U.S. shares strategic and security concerns with other allies as well as friendly nations with whom we have no alliance arrangement. We will expand cooperation with these non-NATO Allies and friendly nations and will assist them in developing and maintaining mutually beneficial, indigenous defense capabilities. We will approve the sale of defense equipment, with appropriate safeguards taken to keep technology secure from exploitation by our adversaries, to those nations whose policies are in consonance with ours and those of our NATO Allies.

## Major Accomplishments

### NATO Armaments Cooperation and Defense Trade

The Congress, in the Roth-Glenn-Nunn amendment to the 1986 Department of Defense Authorization Act, has recognized the benefits of an improved free world's defense posture to be realized through cooperation with our allies in the research, development, production, and fielding of armaments systems.

We must leave no doubt of our commitment to maintain adequate Alliance conventional capabilities. Armaments cooperation built on a solid appreciation for the commitment to the protection of the West's technological lead is one of the primary means to maintain these conventional capabilities. In establishing operational and design requirements for future major weapons systems, we consult with European counterparts. Cooperative joint research, development, production and acquisition programs will be thoroughly explored, particularly where common operational and design requirements can be established; mission effectiveness would be maintained at an acceptable level; technology sharing, on a bilateral basis, would provide near equal benefits to cooperating nations; economies of scale and/or avoidance of duplicative costs are possible; and standardization and interoperability of NATO forces and equipment would be enhanced.

Congressional authorization to set aside $250M to be used exclusively for NATO cooperative programs and the $125M appropriated in FY 1986 are strong and much appreciated signals from the Congress in support of arms cooperetion with our NATO allies. Our actions will reinforce our commitment to Allied cooperation and be fully in keeping with the Congressional intent of this resolution.

We are moving forward on a number of fronts to increase transatlantic defense industrial cooperation. The Services have taken a number of actions that have focused on increased interaction and cooperation with our NATO partners. The Services have been asked to thoroughly consider allied capabilities before any new developments are begun. They will give special management attention to collaborative development programs, and acquisition of existing equipment from other Alliance nations.

The Emerging Technologies Initiative was launched within NATO to assure priority on the application of emerging technologies in improving conventional military capabilities. A small number of force multiplying systems have been endorsed by Ministers for special tracking and management attention under the purview of the CNAD, with a view to acheiving in-service dates as close to 1990 as practicable.

The Department of Defense has an ongoing Foreign Weapons Evaluation Program funded at $17M in FY86. The objective of this program is to evaluate foreign weapons, which are in development or in service, that might be purchased or developed further for inclusion in the U.S. inventory. While the sums involved are small in relative terms, the results are significant in terms of reducing U.S. R&D costs, accelerating the introduction into service of new systems, promotion of standardization and interoperability of fielded systems with our allies, and achievement of procurement cost advantages.

## Non-NATO Armaments Cooperation and Defense Trade

- Northeast Asia (Korea, China)

In Northeast Asia, we continue to assist the Republic of Korea through technological consultation and cooperative armaments development; i.e., tank and missile development. We are thereby strengthening the capabilities of that nation to maintain its freedom and independence.

Modernization of the People's Republic of China's defensive capability is being supported within specific mission areas; i.e., anti-tank, air defense, artillery, and surface ship anti-submarine warfare. These do not threaten the security of the U.S., its allies, or other friendly nations in the Pacific Basin, but are significant in the growth of common interests between our nations. Congress has been advised of our initial Foreign Military Sales case with China which covers artillery fuzes and detonators. Other sales and co-production programs are under active discussion.

- Two-Way Technology Cooperation with Japan

As Japan has a considerable base of technology that could benefit U.S. defense systems, we have expanded our efforts to develop technology and systems cooperation with Japan, with particular emphasis being placed on encouraging a flow of Japanese military technology to the U.S. The benefits of increased cooperation with Japan are several: (1) a strengthened U.S. industrial base, resulting from the infusion or stimulus of Japanese technology in those areas in which Japan has a lead; (2) more efficient use of our R&D resources, as we avoid duplicating Japanese development efforts and focus our attention on developing and introducing better systems sooner; and, (3) improved interoperability with Japanese fielded systems, thereby strengthening the security force structure in the Northern Pacific. In this regard, we are pursuing the August 1984 recommendations of the Defense Science Board (DSB) and work regularly with private sector advice from the Defense Policy Advisory Committee on Trade (DPACT).

Each of the Services has designated a Senior National Representative (SNR) to organize and manage a coherent program of technological cooperation with Japan and to be the principal contact within his Service to explore possibilities for joint research and development. Separately, technical experts in specific mission areas assess the threat, the systems and technologies available to meet that threat, and the systems and technologies in development and needed for development in that specific mission area. The first two of such groups have been established in the air defense and $C^3$ mission areas. We have completed a survey and published a report on the Electro Optics/Millimeter - Microwave(EO/MMW) industry in Japan, and worked out with the Japanese government procedures for the transfer of Japanese military technology to the U.S.

- Southeast Asia, South Asia and Australia

In Southeast Asia, programs of mutual benefit are being explored with Indonesia and Singapore, and we are working closely with other nations in the area against a backdrop of greater Soviet presence in the South China Sea. Cooperative programs with Australia continue to progress and new initiatives are under discussion. Evolving technical cooperation with India is a dynamic development which is being pursued in the wake of Presidential initiatives in the Asian subcontinent.

- Industrial Cooperation with Pakistan

In Pakistan, defense industrial cooperation is becoming a significant factor in the U.S.-Pakistan relationship. This agreement, which is designed to improve the defense industrial base; i.e., tank overhaul, aircraft overhaul, and munitions production. The cooperation will increase in importance as Pakistan's forces acquire more U.S. equipment under our security assistance to that nation.

- R&D Efforts with Friendly Middle East Nations

Cooperation with Israel continues and has provided valuable battle tested information and equipments to the U.S. The Memorandum of Agreement between the U.S. and Israel has led to significant exchanges of technical information, cooperative R&D programs on new systems, exchanges of scientists and engineers, and U.S. procurement of proven Israeli weapon systems.

The U.S.-Egypt Defense Production Assistance Agreement remains an important part of our relations with Egypt. This program, is designed to improve Egypt's defense industrial base; i.e., tank overhaul and radar production. It is a principal element in our relationship with one of the leading nations in this critical region of the world.

- Latin America

We are investigating the feasibility of defense industrial cooperation programs in the Central American region. We expect to aid Central American countries to assess some of their most important military requirements and to help them establish industries which can economically support their defense capabilities. Bilateral cooperation with Brazil has been enhanced through cooperation in scientific and engineering exchanges and will be developed further as the size and sophistication of Brazil's defense industry grows.

## Challenges and Opportunities

We must continue to look to international cooperation in the research, development and production of armaments as a means of strengthening the security and economic base of the free world. Through partnership with our allies we can build better systems. With greater standardization and common procurements we can enhance economies of scale, lower procurement costs, and strengthen the interoperable character of our forces. In addition, involvement in industrial arrangements should result in more work for these industries, less unemployment, and more defense equipment for financial resources expended.

DoD currently has reciprocal memoranda of understanding with NATO allies to lessen or remove barriers to defense trade. Renewal of these agreements will begin in 1986, and the DoD has proposed to transition these bilateral agreements into a U.S.-NATO Europe agreement. This would be a step toward desired integration of the European defense market. Western security and technology cooperation in armaments within NATO will be greatly helped if Europe is able to organize defense research, development and production on a scale more comparable to the scale of the U.S. market. Through the Independent European Program Group in NATO and the Western European Union, important work toward this objective is already underway.

Japan is the second largest economy in the world and technologically mature. Our programs recognize the need to develop a new relationship and develop a two-way flow of technology.

We must recognize that most of the international cooperation with NATO, Japan, and others--will be carried out on an industry-to-industry basis. We emphasize development of a government-to-government environment that encourages such technology cooperation.

## TECHNOLOGY TRANSFER

### Purpose

The transfer and control of militarily-critical technology is inseparably linked to our international cooperative R&D efforts. Of paramount importance to DoD is the fundamental concern for the development, production and acquisition of superior quality weapon systems.

The sharing of our advanced weapons technology with our allies is in the foremost national interest of the U.S. Only through proper management of this technology transfer can its diversion to the Soviet and Eastern bloc countries be prevented.

Technology transfer is concerned with the transfer and control of munitions and strategic trade (dual use) products and manufacturing know-how, such as computer-aided design and manufacturing systems and automatic test and inspection equipment. Detailed technical discussions on a continuing basis are taking place between the U.S., Western Europe, and Japan on selective revision of the Coordinating Committee (COCOM) list to deny the Soviets key items without interfering with legitimate non-strategic trade.

The ultimate goal is to deny the Soviets and Eastern bloc countries documents, hardware, technologies, and manufacturing capabilities that will accelerate their military programs, while ensuring the health of the U.S./allied defense industrial base.

## Major Achievements

A comprehensive review of the entire Militarily Critical Technologies List (MCTL) was undertaken to both remove technologies that no longer are deemed to be militarily critical and to include a number of newly developing technologies which have military significance.

Support was given to the preparation and negotiation of technical proposals to COCOM. Through our initiative COCOM has accepted new coverage in several areas previously uncontrolled. For example, major revisions to the International List were made in the area of robotics and automated industrial control systems. In addition, improvements were made to the International Munitions List particularly in the areas of SDI technologies where new controls were introduced. At the same time, out-of-date controls on lower-level technologies no longer of strategic significance, such as those on low-level personal computers, were eliminated.

Special studies were initiated to support technology security activities, for example, the studies of robotics technology and of Soviet technology needs pertaining to the MCTL. A program was initiated to examine the foreign capabilities for the MCTL entries. Over 200 items were analyzed in terms of the capability of other nations to supply items of equal quality in suitable quantity. Special studies also have been performed to examine current and future weapon systems in terms of their critical technologies and linkage to the MCTL. Furthermore, we are working with selected contractors to assess the technological capabilities of allied nations to provide support to the SDI program.

## Goals-Short Term

As required by the Export Administration Act of 1985, a review of the Militarily Critical Technologies List (MCTL) will be made to ensure that it adequately reflects national security concerns while maintaining minimum interference with the export of non-critical technologies. The program to assess foreign capabilities for the MCTL will be accelerated.

This review will lead to a revised MCTL, and an unclassified version will again be published and released to the general public. Assistance will be provided to accelerate implementation of the MCTL in the export control process.

Technical proposals, leadership, and support will be provided for COCOM negotiation of revisions to the International Control List.

We will continue to support the newly established Defense Technology Security Administration (DTSA) by providing advice and support for the technical aspects of the DoD technology security program.

## Goals-Long Term

Primary attention will be given to facilitating the sharing of SDI and other military technologies with our friends and allies in accordance with U.S. international obligations, including the ABM treaty of 1972. This sharing will be conducted in such a manner as to safeguard these technologies against unauthorized transfer to potential adversaries.

Technical leadership will continue to be provided to support the U.S. objective of achieving a tighter control of critical technologies derived from the MCTL effort. Meanwhile, recommendations for reduction and elimination of product controls will continue for those technologies no longer judged to be strategically significant, thereby disposing of unnecessary burdens on U.S. exporters.

Through presently established forums, dialogue will continue with industry to improve their understanding of the critical technology transfer issues as they are related to U.S. foreign policy and national security objectives.

# APPENDIX A

## OVERVIEW OF RESEARCH AND DEVELOPMENT BUDGET

A-2 Appropriation Categories As a Percentage of the Defense Budget

A-3 RDT&E by Component

A-4 RDT&E by Budget Activity

A-5 RDT&E by R&D Category

A-6 RDT&E by Performer

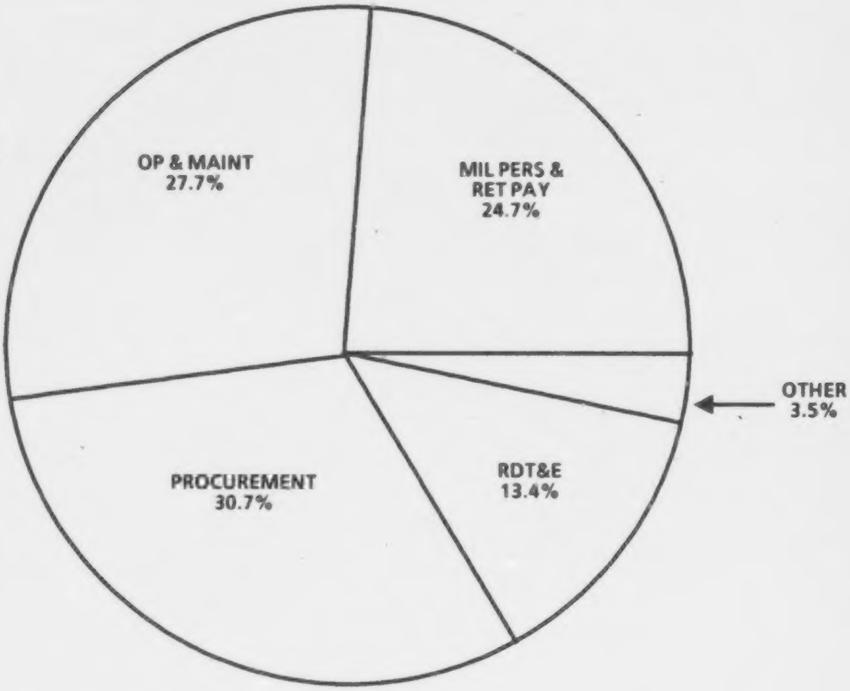
A-7 RDT&E by Defense Programs

# APPROPRIATION CATEGORIES AS A PERCENTAGE OF THE DEFENSE BUDGET

## BUDGET AUTHORITY ($ BILLIONS)

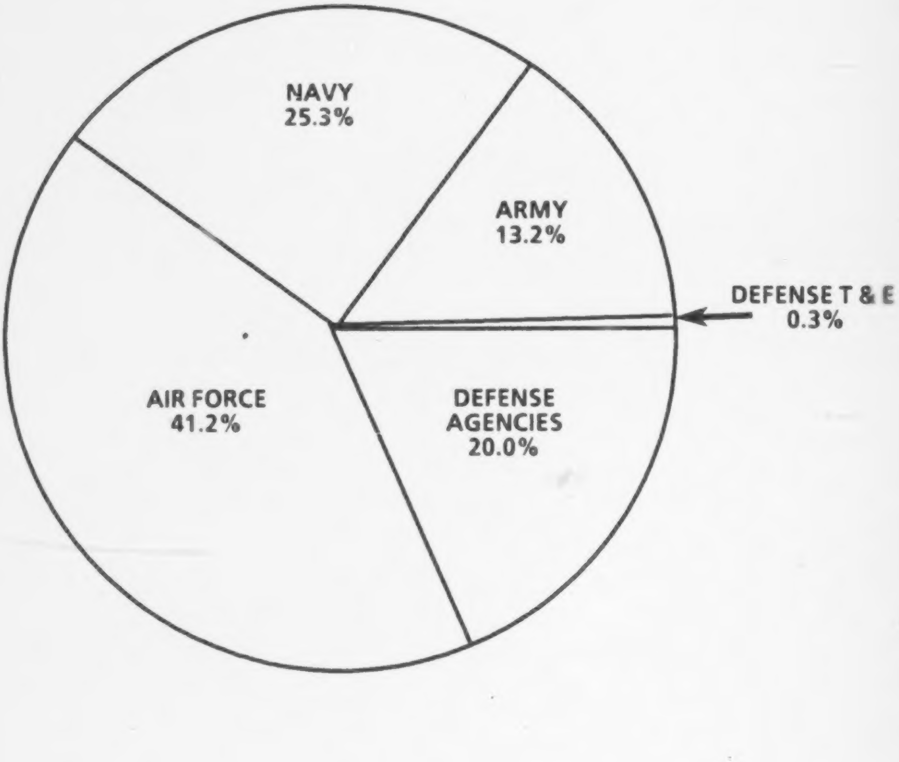
### FY 1987 BUDGET ESTIMATE

| | FY 1985 | % | FY 1986 | % | FY 1987 | % |
|---|---|---|---|---|---|---|
| Mil Personnel | 67.8 | 23.7 | 67.9 | 23.5 | 76.8 | 24.7 |
| Oper & Maint | 77.8 | 27.1 | 78.7 | 27.2 | 86.4 | 27.7 |
| Procurement | 96.8 | 33.8 | 97.3 | 33.6 | 95.8 | 30.7 |
| RDT&E | 31.3 | 10.9 | 35.5 | 12.3 | 42.0 | 13.4 |
| Mil Con | 5.5 | 1.9 | 5.6 | 1.9 | 6.8 | 2.2 |
| Family Housing | 2.9 | 1.0 | 2.9 | 1.0 | 3.4 | 1.1 |
| Other | 4.7 | 1.6 | 1.5 | 0.5 | 0.5 | 0.2 |
| TOTAL DOD | 286.8 | 100.0 | 289.4 | 100.0 | 311.6 | 100.0 |



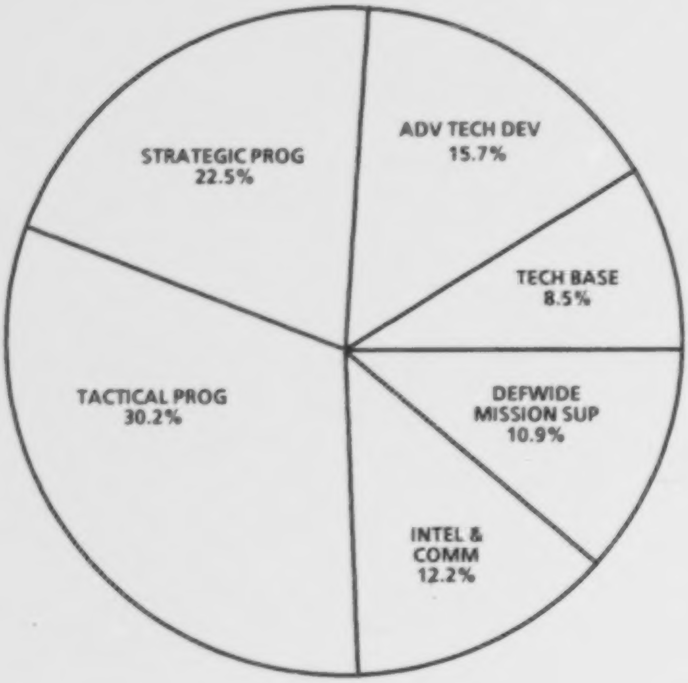
# RDT&E BY COMPONENT
## TOA ($ MILLIONS)
### FY 1987 BUDGET ESTIMATE

| | FY 1985 | % | FY 1986 | % | FY 1987 | % |
|---|---|---|---|---|---|---|
| Army | 4305.2 | 14.0 | 4841.5 | 13.7 | 5550.3 | 13.2 |
| Navy | 9070.9 | 29.4 | 10076.9 | 28.4 | 10586.8 | 25.3 |
| Air Force | 13283.5 | 43.0 | 13787.4 | 38.9 | 17275.4 | 41.2 |
| Def Agencies | 4150.9 | 13.4 | 6642.4 | 18.7 | 8364.3 | 20.0 |
| Def T & E | 59.0 | 0.2 | 118.5 | 0.3 | 141.8 | 0.3 |
| Def OT & E | -- | -- | -- | -- | 11.3 | -- |
| TOTAL RDT&E | 30869.5 | 100.0 | 35466.7 | 100.0 | 41929.9 | 100.0 |



# RDT&E BY BUDGET ACTIVITY
## TOA ($ MILLIONS)
### FY 1987 BUDGET ESTIMATE

| | FY 1985 | % | FY 1986 | % | FY 1987 | % |
|---|---|---|---|---|---|---|
| **Technology Base** | 3120.7 | 10.1 | 3449.1 | 9.7 | 3585.3 | 8.5 |
| **Advanced Tech Dev** | 2750.6 | 8.9 | 4234.3 | 11.9 | 6574.7 | 15.7 |
| **Strategic Prog** | 8169.0 | 26.5 | 8054.4 | 22.7 | 9429.6 | 22.5 |
| **Tactical Prog** | 9062.2 | 29.4 | 10901.0 | 30.8 | 12671.5 | 30.2 |
| **Intel & Comm** | 3953.0 | 12.8 | 4703.4 | 13.3 | 5102.9 | 12.2 |
| **Defwide Mission Sup** | 3814.0 | 12.3 | 4124.5 | 11.6 | 4566.0 | 10.9 |
| **TOTAL RDT&E** | 30869.5 | 100.0 | 35466.7 | 100.0 | 41929.9 | 100.0 |

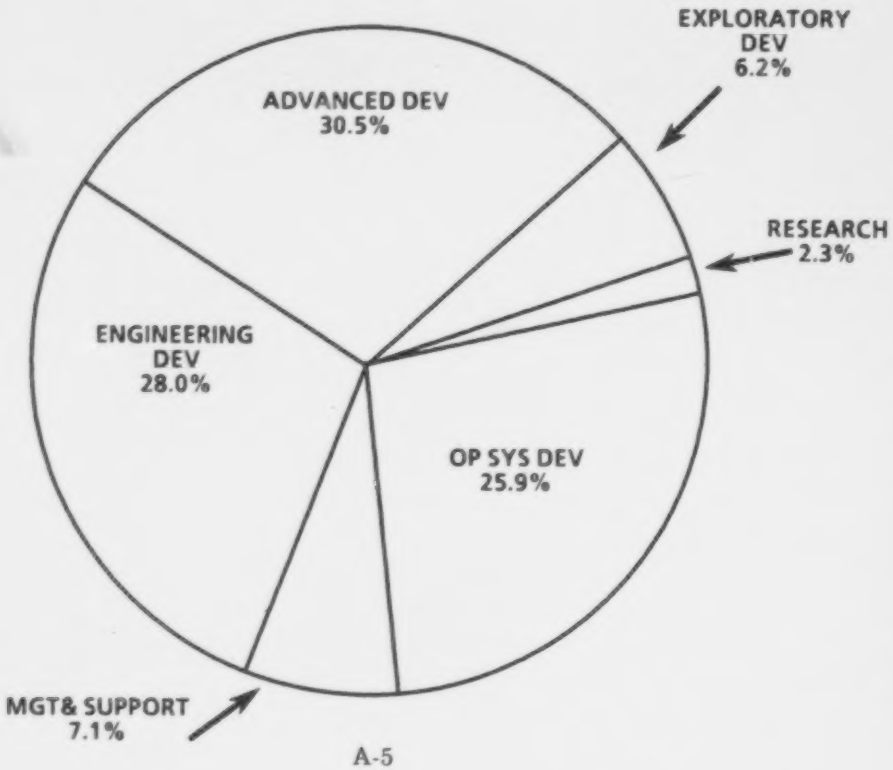


# RDT&E BY R&D CATEGORY

## TOA ($ MILLIONS)

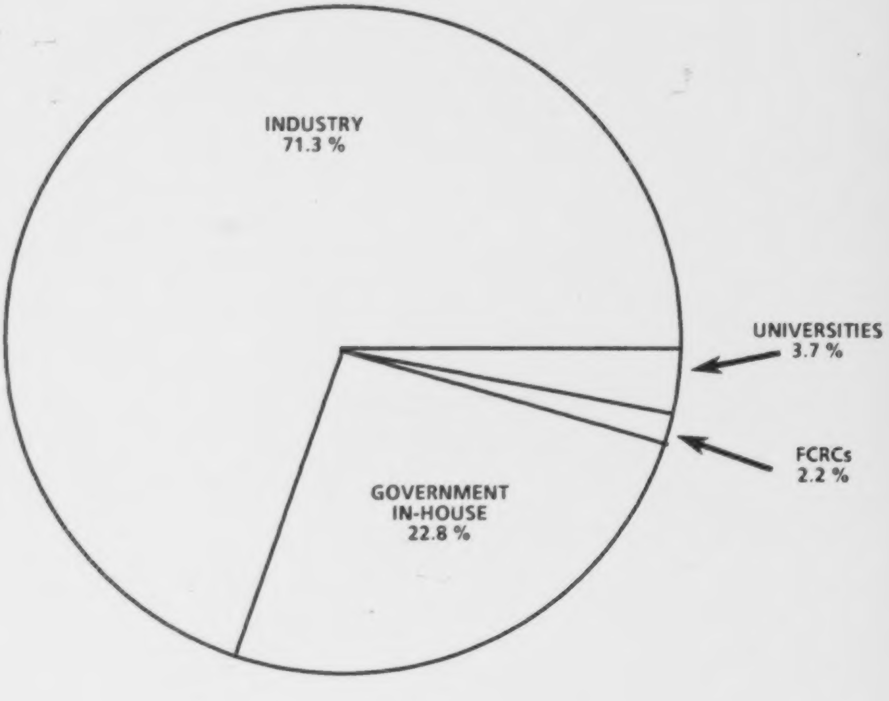
### FY 1987 BUDGET ESTIMATE

| | FY 1985 | % | FY 1986 | % | FY 1987 | % |
|---|---|---|---|---|---|---|
| Research | 852.3 | 2.8 | 1024.2 | 2.9 | 985.8 | 2.3 |
| Explor Dev | 2268.4 | 7.3 | 2424.9 | 6.8 | 2599.4 | 6.2 |
| Adv Dev | 6743.0 | 21.8 | 9875.3 | 27.8 | 12775.8 | 30.5 |
| Engin Dev | 10490.8 | 34.0 | 10149.3 | 28.6 | 11717.5 | 28.0 |
| Mgt & Sup | 2516.6 | 8.2 | 2611.1 | 7.4 | 2972.8 | 7.1 |
| Op Sys Dev | 7998.4 | 25.9 | 9382.0 | 26.5 | 10878.5 | 25.9 |
| TOTAL RDT&E | 30869.5 | 100.0 | 35466.7 | 100.0 | 41929.9 | 100.0 |



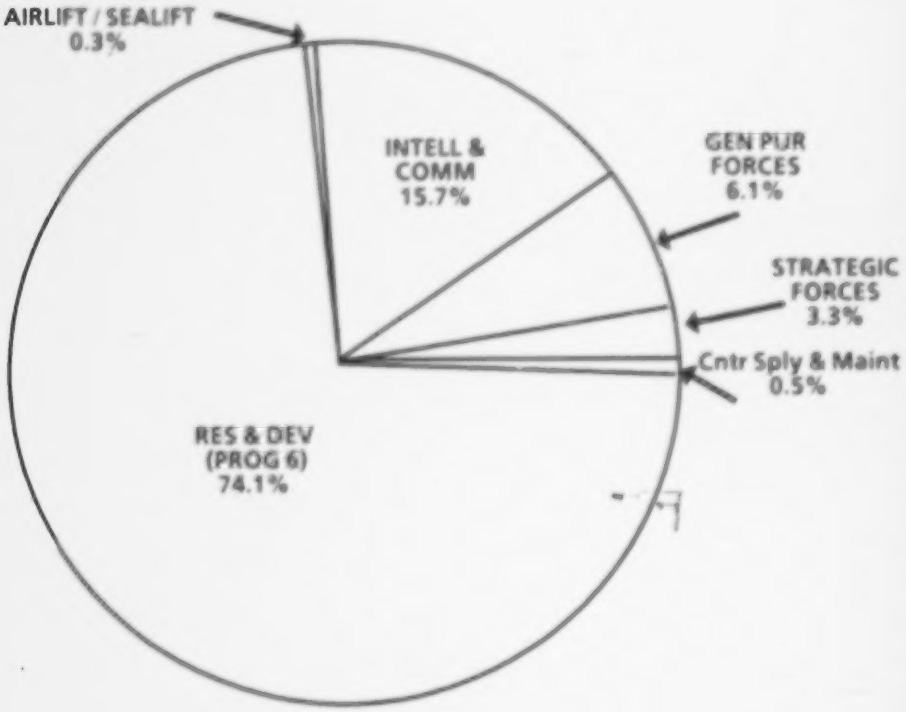
# RDT&E BY PERFORMER
## TOA ($ MILLIONS)
### FY 1987 BUDGET ESTIMATE

| | FY 1985 | % | FY 1986 | % | FY 1987 | % |
|---|---|---|---|---|---|---|
| Industry | 21961.6 | 71.1 | 25418.0 | 71.7 | 29895.8 | 71.3 |
| Govt In-House | 7069.6 | 22.9 | 7940.9 | 22.4 | 9570.7 | 22.8 |
| Federal Contract Research Ctrs (FCRCs) | 700.4 | 2.3 | 764.7 | 2.2 | 912.8 | 2.2 |
| Universities | 1137.9 | 3.7 | 1343.1 | 3.8 | 1550.6 | 3.7 |
| TOTAL RDT&E | 30869.5 | 100.0 | 35466.7 | 100.0 | 41929.9 | 100.0 |



# RDT&E BY DEFENSE PROGRAMS
## TOA ($ MILLIONS)
### FY 1987 BUDGET ESTIMATE

| | FY 1985 | % | FY 1986 | % | FY 1987 | % |
|---|---|---|---|---|---|---|
| Strat Forces | 777.5 | 2.5 | 1109.4 | 3.1 | 1392.4 | 3.3 |
| Gen Purp Forces | 1931.5 | 6.3 | 2016.4 | 5.7 | 2578.9 | 6.1 |
| Intel & Comm | 5025.4 | 16.3 | 5931.1 | 16.7 | 6589.0 | 15.7 |
| Airlift/Sealift | 36.0 | 0.1 | 80.2 | 0.2 | 112.2 | 0.3 |
| Guard & Reserve | -- | -- | -- | -- | 4.5 | -- |
| R & D (Prog 6) | 22871.1 | 74.1 | 26084.7 | 73.6 | 31051.4 | 74.1 |
| Cntr Sply & Maint | 212.9 | 0.7 | 235.2 | 0.7 | 192.2 | 0.5 |
| Trng, Med, Other | 5.2 | -- | 5.2 | -- | 4.8 | -- |
| Admin & Assoc Act | 5.2 | -- | -- | -- | -- | -- |
| Spt Other Nations | 4.7 | -- | 4.5 | -- | 4.5 | -- |
| TOTAL RDT&E | 30869.5 | 100.0 | 35466.7 | 100.0 | 41929.9 | 100.0 |



# APPENDIX B

# ACRONYMS

| | |
|---|---|
| AAA | Anti-Aircraft Artillery |
| AAW | Anti-Air Warfare |
| ABM | Anti-Ballistic Missile |
| ACM | Advanced Cruise Missile |
| ADP | Automated Data Processing |
| AFAP | Artillery Fired Atomic Projectiles |
| AFATDS | Advanced Field Artillery Tactical Data Systems |
| AMRAAM | Advanced Medium Range Air-to-Air Missiles |
| A&L | Acquisition & Logistics |
| ALCM | Air Launched Cruise Missile |
| ASARS | Advanced Synthetic Aperture Radar System |
| ASAT | Anti-Satellite |
| ASMS | Advanced Strategic Missile System |
| ASPJ | Airborne Self-Protection Jammer |
| ASTF | Aeropropulsion Systems Text Facility |
| ASW | Anti-Submarine Warfare |
| ATA | Advanced Tactical Aircraft |
| ATB | Advanced Technology Bomber |
| ATD | Advanced Technology Demonstration |
| ATF | Advanced Tactical Fighter |
| ATACMS | Army Tactical Missile System |
| ATM | Anti-Tactical Missile |
| ATSD/AE | Assistant to the Secretary of Defense for Atomic Energy |
| AWACS | Airborne Warning and Control System |
| BMEWS | Ballistic Missile Early Warning System |
| BVR | Beyond-Visual Range |
| CAS | Close Air Support |
| CCL | Commodity Control List |
| CCM | Counter-Countermeasure |
| CCPDS-R | Command Center Processing Display System Replacement |
| CELV | Complementary Expendable Launch Vehicle |

| | |
|---|---|
| CI | Conventional Initiatives |
| CINC | Commander-in-Chief |
| CNAD | Conference of National Arms Directors |
| COCOM | Coordinating Committee |
| COMSEC | Communications Security |
| CRAFS | Civil Reserve Auxilliary Fleet Ships |
| CUCV | Commercial Utility Cargo Vehicle |
| DAACM | Direct Airfield Attack Combined Munition |
| DAIP | Defense Acquisition Improvement Program |
| DARPA | Defense Advanced Research Projects Agency |
| DDN | Defense Data Network |
| DEW | Distant Early Warning |
| DIVAD | Divisional Air Defense (Gun) |
| DNA | Defense Nuclear Agency |
| DoD | Department of Defense |
| DoE | Department of Energy |
| DPACT | Defense Policy Advisory Committee on Trade |
| DSARC | Defense System Acquisition Review Council |
| DSB | Defense Science Board |
| DSN | Defense Switching Network |
| DTSA | Defense Technology Security Administration |
| ECM | Electronic Countermeasures |
| EFP | Explosively Formed Penetrator |
| ELF | Extremely Low Frequency |
| EO | Electro Optics |
| FAAD | Forward Area Air Defense |
| FIDS | Facility Intrusion Detection System |
| FSD | Full-Scale Development |
| FSE | Fire Support Element |
| FTI | Fixed Target Indicator |
| FOG-M | Fiber Optic Guided Missile |
| FRG | Federal Republic of Germany |
| GACC | Ground Attack Control Center |
| GLCM | Ground Launched Cruise Missile |
| GNP | Gross National Product |
| GPS | Global Positioning System |
| GRU | Soviet Military Intelligence Organization |
| GWEN | Ground Wave Emergency Network |

| | |
|---|---|
| HARM | High Speed Anti-Radiation Missile |
| HF | High Frequency |
| HELP | Howitzer Extended Life Program |
| HIP | Howitzer Improvement Program |
| HMMWV | High Mobility Multi-Purpose Wheeled Vehicle |
| HTM | Hardened Target Muniton |
| ICBM | Intercontinental Ballistic Missile |
| IIR | Imaging Infrared |
| IL | International List |
| IML | International Munitions List |
| INEWS | Integrated Electronic Warfare System |
| IOC | Initial Operational Capability |
| IP&T | International Programs and Technology |
| ITV | Instrumented Test Vehicle |
| IUS | Initial Upper Stage |
| JAFE | Joint Advanced Figther Engine |
| JDS | Joint Development System |
| JRMB | Joint Requirements Management Board |
| JSEAP | Joint Suppression of Enemy Air Defense |
| JTACMS | Joint Tactical Missile System |
| JTFP | Joint Tactical Fusion Program |
| JTIDS | Joint Tactical Information Distribution System |
| JSTARS | Joint Surveillance & Target Attack Radar System |
| JVX | Joint Service Advanced Vertical Lift Aircraft |
| KGB | Committee for State Security |
| KE | Kinetic Energy |
| LAMP-H | Lighter Amphibian, Heavy Lift |
| LANTIRN | Low Altitude Navigation and Targeting Infrared System for Night |
| LAV | Light Armored Vehicle |
| LHX | Lightweight Experimental Helicopter |
| LLLGB | Low Level Laser Guided Bomb |
| LRP | Long Range Planning |
| MAAWEC | Maritime Anti-Air Warfare Executive Committee |
| MAPS | Modular Azimuth Positioning System |
| MCE/ TAOC | Marine Corps Modular Control Equipment/ Tactical Air Operational Control |

| | |
|---|---|
| MCTL | Militarily Critical Technologies List |
| MICOM | U.S. Army Missile Command |
| MILNET | Military Network |
| MIMIC | Microwave/Millimeter Wave Monolithic Integrated Circuits |
| MIRPS | Mobile Individual Resource Protection Sensor |
| MLRS | Multiple Launch Rocket System |
| MMR | Millimeter Wave Radar |
| MMW | Millimeter Wave |
| MPG | Mobile Projected Gun System |
| MSIP | Multi-Stage Improvement Program |
| MTI | Moving Target Indicator |
| MV | Miniature Vehicle |
| NASA | National Aeronautics & Space Administration |
| NATO | North Atlantic Treaty Organization |
| NAVSTAR | Navigation Satellite Timing & Ranging |
| NBC | Nuclear Biological & Chemical |
| NCA | National Command Authorities |
| NEACP | National Emergency Airborne Command |
| NIS | NATO Indentification System |
| NSNF | Non-Strategic Nuclear Forces |
| NWDG | Nuclear Weapons Development Guidance |
| OJCS | Office of the Joint Chiefs of Staff |
| OMG | Operational Manuever Group |
| OM | Office of Munitions |
| OKR | Experimental Design Wor |
| OTH-B | Over-the-Horizon Backscatter |
| OTHR | Over-the-Horizon Radar |
| OSD | Office of the Secretary of Defense |
| PENAIDS | Penetration Aids |
| PLSS | Precision Location Strike System |
| RAIDS | Airborne Intrusion Detection System |
| RAM | Rolling Airframe Missile |
| R&AT | Research & Advanced Technology |
| SADARM | Sense & Destroy Armor |
| SAM | Surface-to-Air Missile |
| SCSC | Strategic Conventional Standoff Capability |
| SDI | Strategic Defense Initiative |

| | |
|---|---|
| SEAD | Suppression of Enemy Air Defense |
| SFN | Sensor Fuzed Weapon |
| SICMB | Small ICBM |
| SKIPPER | Laser Guided Bomb |
| SLBM | Submarine Launched Ballistic Missile |
| SNR | Senior National Representative |
| SP | Self-Propelled |
| SRAM | Short Range Attack Missile |
| SSBN | Nuclear Submarine |
| STAFF | Smart Target Activated Fire & Forget |
| STARS | Software, Technology for Adaptable, Reliable Systems |
| STOL | Short Takeoff & Landing |
| S&T | Science & Technology |
| SWA | Southwest Asia |
| TACAMO | Take Charge & Move Out |
| TACMS | Tactical Missile System |
| T&E | Test & Evaluation |
| TGW | Terminally Guided Warhead |
| TOW | Tube Launched, Optically Tracked Wire Guided |
| TSPI | Time Space Position Instrument |
| USDRE | Under Secretary of Defense for Research & Engineering |
| VHSIC | Very High Speed Integrated Circuits |
| VPR | Military Industrial Commission |
| WIS | WWMCCS Information System |
| WWMCCS | Worldwide Military Command & Control System |

Mr. Price. Mr. Dickinson.

Mr. Dickinson. Thank you, Mr. Chairman.

Dr. Hicks, there are a couple of specific weapons systems I wish you would discuss with us.

I think one of the highest priorities that the Air Force has is the AMRAAM. Now, we have been very concerned about this, also, so much so that the year before last we hired two consultants to look into the program for us independent of what DOD says and Air Force says because we recognized the need.

Nobody denies the need for the capability that the AMRAAM is supposed to afford the Air Force. It boils down to, I think, affordability, really, and so there was a great discrepancy between what our independent team concluded would be the ultimate cost and what was being touted by the Air Force.

It is my understanding now that the Secretary of Defense has vacillated. First he wanted to kill it; then he changed his mind, and now he is about ready to certify the AMRAAM with a cap.

The figures that we were using that our team had come back ~~with was~~ they thought the unit cost per missile would be around $750,000. The Air Force is saying it would not run over $450,000. Of course, we started out several years ago with a design cost of $75,000 per, but it sort of grew after that.

It is my understanding now that the Secretary is about to certify—this is just in-house rumor and that is the reason I ask you to see if you could help me clarify it——

Dr. Hicks. Rumors are always very good.

Mr. Dickinson [continuing]. That the Secretary is considering seriously certifying production but putting a cap on it of somewhere around $300,000 per missile.

First, is this so? Second, are there any parameters changing? Is this the same missile it started out to be or are they reducing the capabilities?

Could you give us a discussion on that, please? Correct me where I am wrong, first.

Dr. Hicks. I would, rather than correct you, Congressman Dickinson, say what I think the facts are. Some of what you say is correct, some of it may be a little bit off.

The Secretary, by law, if the program is to proceed, must certify that it will come under a cap that was specified by Congress as a matter of fact last year. So if we want to proceed with AMRAAM, which I consider completely an important program to the Air Force, we will have to decide whether we can or can not do that.

I don't want to prejudge the Secretary in what he will do. I believe that we have enough information, very hard data, by which I mean "not to exceed" data from the contractors, that we will be able to certify that missile.

I must say I don't think caps are a good thing. I think they are a false constraint of a situation; it might have turned out, for example, that we could not certify—suppose it had been $100 million over—an important program like this. In a situation such as this one the Secretary, who is extremely honest about these things and really tries to be very, very careful about it, would decide he couldn't certify it and we would lose a missile system that we desperately need.

Mr. **Dickinson**. Or else have to come back to the Congress.

Dr. **Hicks**. Yes; or go back to the Congress.

The other side of this is whether or not the missile has changed, and the answer to that is absolutely not. There has been no change in specifications.

The only changes made to that missile will be changes to make it more producible. We will have no impact in any way of anything going wrong with the missile or its capabilities.

Mr. **Dickinson**. May I yield for a housekeeping chore.

Mr. **McCurdy**. I would like to move, Mr. Chairman, that the chairman be authorized to go into executive session for today and 5 additional consecutive days of hearings for the purpose of receiving classified information affecting the national security.

Mr. **Price**. The question is on the motion. The clerk will call the roll.

Mr. **Battista**. Mr. Price.

Mr. **Price**. Aye.

Mr. **Battista**. Mr. McCurdy.

Mr. **McCurdy**. Aye.

Mr. **Battista**. Mr. Hertel.

Mr. **Hertel**. Aye.

Mr. **Battista**. Mr. Darden.

[No response.]

Mr. **Battista**. Mr. Bennett.

Mr. **Bennett**. Aye.

Mr. **Battista**. Mr. Nichols.

[No response.]

Mr. **Battista**. Mr. Dellums.

[No response.]

Mr. **Battista**. Mr. Dickinson.

Mr. **Dickinson**. Aye.

Mr. **Battista**. Mr. Courter.

Mr. **Courter**. Aye.

Mr. **Battista**. Mr. Badham.

[No response.]

Mr. **Battista**. Mr. Davis.

Mr. **Davis**. Aye.

Mr. **Battista**. Mr. Stump.

[No response.]

Mr. **Battista**. On that vote, seven members voted in the affirmative.

Mr. **Price**. The motion is agreed to.

Mr. **McCurdy**. Will the gentleman continue to yield concerning the question on the AMRAAM that he raised?

Mr. **Dickinson**. Certainly.

Mr. **McCurdy**. Secretary Hicks, I think the ranking member and I were both involved in the conference on the writing of the compromise language on the AMRAAM. One of the requirements within the certification were, first of all, you couldn't change the specs; it had to meet the same design specs on the missile. Second, the overall cost. Third, the total units.

I was recently at the plant, one of the plants of the contractors in this competition, and I was informed that the total unit volume has been increased, that certification will change it from 17,000 units to 24,000. Is that incorrect?

Mr. DICKINSON. For both services?

Dr. HICKS. The confusion comes from the fact there has been 17,000 for the Air Force and the Navy was discussing another 7,000 missiles, 24,000 total. But that was carefully spelled out in what was called the cap. So the number of units involved in that cap have not changed at all.

Mr. MCCURDY. Thank you.

Mr. DICKINSON. It was 17 and 7 last year.

Mr. MCCURDY. That is what the cap was on our language. But if the Navy's—you are saying the per unit cost is driven down because of the Navy buy as opposed to the straight cap on the 17,000.

Dr. HICKS. Yes.

Mr. MCCURDY. Can you make your cap on the price of 300K with the 17,000-unit buy? That is the question.

Dr. HICKS. First, I want to say that it is really up to the Secretary to make a decision about whether he signs the cap or not. I can't answer that.

Mr. MCCURDY. Let me rephrase it. The question is that in the conference language, the Secretary is required to certify that he can or cannot meet those requirements.

Dr. HICKS. Yes.

Mr. MCCURDY. To your knowledge, can he meet those requirements for certification at this point?

Dr. HICKS. To my knowledge, I would be satisfied that he can.

Mr. MCCURDY. He can?

Dr. HICKS. Yes; but I don't want to speak for the Secretary.

Mr. MCCURDY. Thank you.

Mr. DICKINSON. I don't want to put words in your mouth, but as head of RDT&E, you have the responsibility of providing the facts and figures and recommendations to him and he has to depend on your judgment.

Dr. HICKS. My recommendation will be that we proceed with the program.

Mr. DICKINSON. And that he can cap it at or under the figure that we have mandated.

Dr. HICKS. Yes, sir.

Mr. DICKINSON. To another subject, if I might, one of my pet rocks these days is air-to-air capability with helicopters. I think it is inevitable that in order to give air superiority over the battlefield in the next conventional war, should there be one, that this is going to be provided more by rotary wing than by fixed wing.

We know, we see what the Soviets are doing with their Hind-D, I think the last was 23, then the Hokum, but they are hanging air-to-air capability on just about everything they fly with a rotary wing.

We have been very tardy in coming along here. I understand that we are looking at putting the Stinger on whatever we have flying including the LHX. I don't know whether or not the Stinger is defeatable, but I am concerned we have not given enough emphasis in this field.

Do you think my concern is unwarranted or do you agree with me and do you think we should accelerate our energies in this particular area?

Dr. HICKS. I certainly agree with you, Mr. Dickinson, that the threat is there and it is a real threat. There are different ways of meeting that threat. Some of it is air-to-air, some of it is ground-to-air. Some of the forward air defense activities the Army is now engaged in will in fact attempt to meet much of that threat through ground action.

In order to be very accurate about this as to where we are essentially, and I certainly agree with the requirements, I would rather give you an answer for the record to convey exactly where we are, what we are doing, and how well we should proceed.

Mr. DICKINSON. All right.

[The following information was received for the record]

### HELICOPTER AIR-TO-AIR (ATA) COMBAT CAPABILITY

Analysis of improvements ot the current Soviet armed helicopter (Hind) and of development programs for future Soviet helicopters (Havoc and Hokum) indicate a significant increase in their ATA combat capability. This capability poses a threat to current and future U.S. armed helicopters (AH-1's, AH-64's) which are equipped with weapons designed to meet primarily an air-to-ground mission requirement. Only the Marine Corps's AH-1's are equipped with the Sidewinder air-to-air missile to either defend themselves or to conduct offensive ATA combat operations against the Soviet helicopter threat.

The Services have conducted studies, tests, and evaluations of Soviet helicopter air threat and counters to that threat dating back to 1970, but as of today, only the Marines have a helicopter air-to-air capability. They have procured AIM-9L (Sidewinder) air-to-air missiles for their AH-1J and AH-1T Cobras and began their fielding in July 1985. On 19 February 1986, the Marines fired the missile from the first operational fleet helicopter. About 75 percent of the Marine Corps' AH-1's now carry the Sidewinder and the rest of the force will be equipped by September 1986.

Marine attack helicopter pilots are currently trained in air-to-air combat tactics employing guns, rockets, and the AIM-9L.

The Army has adopted the Stinger missile (man-portable, IR homing, used for forward air defense) for use from the OH-58D (AHIP) and OH-58C scout helicopters. A fiscal year 1987 buy of 720 systems is being requested. R&D work continues to qualify the Stinger on attack (AH-64's and AH-1's) and air cavalry (UH-60's) helicopters also.

The Army still needs to clarify the extent of the air-to-air role of their helicopters. There still lingers the question as to whether that role is strictly defensive, or if it also includes the attack of enemy helicopter for the sake of attack alone.

The Air Force continues to develop its fighter tactics to counter the helicopter threat by expanding the A-10 Joint Air Attack Team (JAAT) employment concept.

There are no current plans to equip Navy helicopters with air-to-air missiles. The Navy will continue to rely on defensive equipment that is, flares and IR suppression.

Mr. DICKINSON. Now, will you direct a copy to my attention because most of the things provided for the record nobody ever sees them.

Dr. HICKS. I will bring it to you myself.

Mr. DICKINSON. They come drifting in a month or two later and everything is closed and you have voted and then you provide it for the record—not you, but that is somehow how it has been in the past.

Dr. HICKS. I will provide it soon.

Mr. DICKINSON. Provide it ASAP and be sure I get a copy of it, if you would.

What do you see as the biggest threat from our reduced budget this year? Where does it impact R&D most?

You say you want to talk about SDI separately and let General Abrahamson talk about that.

Dr. HICKS. I will be glad to answer anything you ask however, it is really his program and he is much more involved in it than I am.

Mr. DICKINSON. I understand. For the SDI program last year they came in with $3.8 billion and we cut it to $2.5 billion. In conference we sent it back at $2.75 billion. What is asked for SDI this year? Do you recall that?

Mr. MCCURDY. $4.8 billion.

Dr. HICKS. Yes; $4.8 billion is correct.

Mr. DICKINSON. We will deal with that later. General Abrahamson can come up here and——

Dr. HICKS. I want to make a statement that has nothing to do specifically with what you get from General Abrahamson.

In this country we have historically had some very interesting things happen when we have put up a lot of money, massive team efforts on major high-risk programs have been made.

A good number of the programs coming out of DARPA have gone into SDI. Some of the very advanced programs, would have gone on at a very slow rate because of the amount of money available and they would have been evaluated based on risk and those of high risk would not have been funded. Yet we have situations historically, including the Nuclear Weapons Program and the Moon Program, which were examples of very high-risk programs, where intensive amounts of effort were put into those programs, and we had successful results.

I can remember as a graduate student in physics being told by, at that time, one of the greatest space experts of all time, that we could never have a rocket reach the Moon because it would collapse of its own weight as we tried to stack it up for launch. Of course, he wasn't using the right energetics. They didn't have the materials and the high-energy fuel then. So he was wrong.

One of the things that I think would be most striking to the Soviet Union is that we are driving into high-risk areas with a lot of extreme capability and out of that I think we can feel reasonably comfortable in terms of the past that we are going to have some major success and that has to be something that will be very discomforting to the Soviets.

Mr. DICKINSON. One final question, and I apologize for taking this much time. Will you give us your thoughts on the proposed 2-year budget cycle for both authorization and appropriation?

Dr. HICKS. I think that is an excellent idea. I have been for it both in industry and here. I think it allows more time to be more statesmanlike in the views of what the programs are. Nothing will change that fast; that 2-year cycle isn't the right cycle.

Not speaking for the administration, although it is my understanding they are also supportive of this; I think it is an excellent idea and I would be personally supportive of it.

Mr. DICKINSON. You think it would save substantial amounts of money, too?

Dr. HICKS. I think it would save a substantial amount of money in terms of the manpower required each year to discuss the programs and work the problems and so on.

Not only that, but it gives you something else; it gives you the kind of planning needed in order to lock things in. It is the same issue as multiyear buy. When a person knows what is going to happen to him he has essentially contained his risk. When he does that he knows how to invest.

So whether it is talent, money, time, both multiyear buys and multiyear planning appropriations the 2-year budget cycle would be very helpful to us.

Mr. DICKINSON. Thank you.

I made this statement and I will make it again. It is amazing how much difficulty this committee had in getting the concept of multiyear contracting through.

We had to fight two other committees of the House and couldn't get it through and finally we got it through and it saved hundreds of millions of dollars and we are saving more each year.

But, you know, just because something saves money as common sense doesn't mean it will pass.

Dr. HICKS. That is what I understand.

Mr. DICKINSON. Thank you.

Mr. PRICE. Mr. McCurdy.

Mr. MCCURDY. I yield to the gentleman from Georgia.

Mr. DARDEN. I thank the gentleman for yielding.

I move now by unanimous consent, I vote aye on the motion to go into executive session.

Mr. PRICE. Without objection.

Mr. DARDEN. Thank you, Mr. Chairman.

Thank you, Mr. McCurdy.

Mr. MCCURDY. There are a couple points, Mr. Secretary, and I don't want to take a lot of time with it but I would like to cover these.

First of all, a comment or two in the strategic areas. One on SDI last year, we came up with $2.5 billion and in this committee; $2.75 billion, as the gentleman from Alabama indicated, in conference, which was an 80 percent increase over the previous year's budget.

Now this year you are asking $4.8 billion and I am just asking what your ability is to absorb those increases in the RDT&E structure. Isn't it darn near impossible under present circumstances?

I am interested in your experience in corporate settings whether or not, given the infrastructure that is there, whether increases of 200 and 300 percent in funding in a given year can adequately be absorbed.

Dr. HICKS. It is very difficult to make a generalized comment on that.

There is no question there will be difficulties. I am sure General Abrahamson recognizes that.

On the other hand, I have personally been involved in programs where we have had very fast growth rates when we were working very quickly toward a piece of hardware 5 years off. I think if you went back to the time of the Man on the Moon Program, you will find very fast growth in portions of that program also. Despite the fact it would be difficult, I think it is doable and I would really trust to the judgment of General Abrahamson.

I regret saying I have not had time to work in the R&D oversight in that area very much, so I have not put myself in a very good position to give you an answer on the specifics of that.

Mr. McCurdy. I suggest when the priorities in the Gramm-Rudman start to take effect in the next few weeks that we should have an understanding of where the cuts will occur, so I would appreciate that you would analyze what you feel is an adequate rate of absorption vis-a-vis the cuts in other areas and whether or not we can maintain the line or continue the increment in a steady research program in this without destroying other systems.

The next question I have is about the ATB. I understand this is classified and some of us have been dealing with that program for a couple years or more. But I am curious; can you give us a general statement of when you believe that this, the numbers at least, will be declassified and when we will get this out into the budget process?

That raises an issue with the Synar amendment and other things as to the overall ability to keep some of these things in the classified arena.

How would you suggest we deal with these and specifically ATB?

Dr. Hicks. Whenever you have a large program that is in the black area that it has to be handled specially. The fact is that the ATB is a very important program and its classification is certainly warranted.

This whole issue is being discussed at the Defense Department now and I don't believe that I am in position to make any comments other than to say that there is discussion going on about the program and clearly we are aware of what is happening over here.

Mr. McCurdy. If they are not brought out soon——

Mr. Dickinson. Will you yield for a clarification?

Mr. McCurdy. Yes.

Mr. Dickinson. You say discussions are going on. You mean vis-a-vis the B-1 or what?

Dr. Hicks. In terms of what we might be able to declassify without giving any real benefit to the Soviet Union and still meet the requirements of Congress.

Mr. Dickinson. You were not saying in terms of abandoning this to go to another program, really?

Dr. Hicks. No, sir.

Mr. Dickinson. All right.

Mr. McCurdy. I would suggest in the near term if those numbers are not brought out into a little broader public domain that the likelihood of that program continuing is becoming more shadowed, or more difficult.

I think we will have to be able to fight with the full arsenal or full——

Dr. Hicks. We all want to have things that we can use for deterrence and the ATB is one of those tools.

I might add, that I have been authorized to say something. The program unit cost of the Advanced Technology Bomber in constant year dollars is within 2 or 3 percent of the program unit costs of the B-1B bomber.

That is a lot of information right there.

Mr. McCurdy. We have had the briefings, too, and as one of the authors of the Nunn-McCurdy amendment on that program unit cost, there are a lot of ways to get to that.

Dr. Hicks. Yes; but these are program unit costs apple to apple.

Mr. McCurdy. Let me make another point here on the MX. Again, as one of the coauthors of the amendment that limited it at 50, and I supported it the whole way, I can assure you, Mr. Secretary, that if you are not going to spend the money on the MX, it is not going to fly. Fifty is the cap; there won't be any more.

I don't think any of the basing modes will work either from—I am telling you the political end of it, here in public. I have told you this privately, but I am telling you publicly, too. I don't see MX going any further.

I am deeply concerned about the viability of the small ICBM, Midgetman. There was a recent article that you were quoted in as saying—not only was it a quote, it alluded to the fact that you were opposed to Midgetman and I would like to have clarification of that, because to me, for the cost to kill to the Soviets on the mobile system, it is so high—you mentioned cost to kill earlier—that the deterrent value is just incredible.

If we want a land-based leg of the Triad, we have to go with Midgetman. That is my personal opinion. I would like to hear yours.

Dr. Hicks. In a different arena, I would like to go over cost figures with you, Mr. McCurdy. They depend heavily upon numbers we don't know.

The problem is in some basing issues, for example, for MX we don't have enough data to make a proper evaluation. We have what we consider to be good estimates from different people, and some of which are contractors, and some of which are Air Force, and they don't always agree. So we will have to get on top of that discrepancy.

Let me say a lot of people have said what you said about MX being not politically viable. I think it is a tragedy. If you say it is true, you are in a position to know more than I.

Mr. McCurdy. We were lucky to get the 50. If we hadn't gotten our amendment, we would have been frozen at 42.

Dr. Hicks. All I can say is there are over 500 thoughtful people in Congress and I can't but wonder how they can say it has got to be this way, because it has been decided without looking at the facts.

You could have, for a small amount of money comparatively, $2 billion, all the rest of the MXs that would be a credible deterrent.

Mr. Dickinson. You know the fact is some don't want it at all, period. So there is no big deal. We are not talking about saving money. They would rather have zero. That is what we are up against.

Dr. Hicks. Having worried about this problem, let's go to the small ICBM and my thoughts feelings about that.

First of all, I very strongly support a land-based ICBM capability. I respect and appreciate the views of people who have expressed the views of the Scowcroft commission and also discussed the small ICBM and how it interacts with certain liberal interpretations, and

I use that with a capital "L", liberal interpretations of what arms control is all about.

The thing that I am concerned about is not that I am against the small ICBM as something that will help us; I am convinced it will be an added deterrent. I don't have total appreciation of the survivability of the modes that you may have in terms of mobile scattering.

On the other hand, regardless of that, taking all those things and accepting them as facts, what I do know is that the Soviets have a mobile missile that is in the 70,000-pound class and could be MIRV'd we know with three warheads.

It is also true that we could have the same capability and in fact in terms of the amount of SS-18 equivalents that it would take to kill if we went out into the same area, the same survivability, by building about 170 larger missiles with a MIRV'd three warhead front end.

Now, we have not looked at that in enough detail but there have been studies made by Rand, and some work has been done by the Air Force in certain areas, people tend to draw away from that.

In fact, there was an interesting quote, out of the Rand report about MIRVing the SICBM. "A three-RV missile would reduce total costs by approximately 40 to 50 percent in dollars and 80 percent in manpower with little or no loss in employment, flexibility, or survivability. But a decision to alter the program to incorporate a three-RV missile would require program slippage and is likely to face congressional opposition."

Now, I believe that, even if it should face congressional opposition, because we could save the American taxpayer at least $20 billion by going to a mobile MIRV'd missile.

Mr. McCurdy. Let me make a couple quick comments, and my colleague, I know, wants to ask some questions.

First of all, I don't think we should be in the process of loading up the Midgetman. The Deutch commission—they were also on the Scowcroft commission—came out with a 33,000-pound version. As one who sits and chairs a subcommittee of Intelligence that looks at targeting and the problems of verification that Soviet mobile systems have, I assure you that the price-to-kill, the cost-to-kill and the deterrent value of those mobile systems is very real, and that it is significant and that sometimes I am amazed on the subcommittee that we hear that theirs is totally untargetable but ours is.

I don't believe that. That is just not——

Dr. Hicks. Nothing is almost never anything. There are no absolutes in this world. But the fact is I am not talking about changing the mobile concept at all. I am talking about putting a 75,000-pound missile on a carrier with a 30-psi capability just like you have on Midgetman doing exactly the same thing you say.

Mr. McCurdy. I won't get into an argument about it now, but the size of the carrier, when you start loading the 70,000 pounds, you limit the options of dispersal, even when you go with the garrison approach.

Dr. Hicks. Not much. We should study it.

Mr. McCurdy. We will take that one on, yes, because I feel very strongly about that one.

Tell me about the JSTARS. Again, in the conference because it was a combination of Intelligence and Armed Services on JSTARS, we had requirements in there on some reporting.

Dr. HICKS. I can tell you what it was.

Mr. MCCURDY. I have to be careful. Maybe you can tell us what is classified or not.

Dr. HICKS. That is classified.

Mr. MCCURDY. We are concerned that we are not following through with the conference language and that the intent—maybe someone didn't understand the intent of the conference. It was pretty darn clear from my standpoint.

Dr. HICKS. I think we understood it. It is called micromanagement, sir.

Mr. MCCURDY. It might have been, but there is no one managing it now.

Dr. HICKS. There is a lot of management. It is a question of who will manage the program, DOD or the congressional staff.

Mr. MCCURDY. Well, no, if we are going to have three, two or one system and whether it would be more effective in the long term to go with a longer term program as opposed to an interim——

Dr. HICKS. No, actually what——

Mr. MCCURDY. And a long-range system.

Dr. HICKS. I think the best technical approach in that design was used to meet both the desires—it turned out to be the right thing to do—of both the Senate staff and House staff. We didn't do it because we wanted to please both staffs, but I think it did.

Mr. MCCURDY. It was a bipartisan group of Members that wrote that language and Mr. Stump was one, I was one, and Senator Nunn was one, and I can assure you staff had very little to do with that, because this is one that we looked at from both committees.

Dr. HICKS. I am talking about the one that came out of the Intelligence Committee in the conference.

Mr. MCCURDY. I mean the conference——

Dr. HICKS. Maybe we are talking about different language.

Mr. MCCURDY [continuing]. From Intelligence and Armed Services on that one. It was a joint committee bipartisan approach of Members who said we want something done here, and you call it micromanaging, but we wanted it done. I am not sure that we have been satisfied.

Dr. HICKS. I think that first of all we cannot talk about it here. We will have to go in to a closed session to do that. In fact, we have to go to a special access session to do it.

Mr. MCCURDY. We can schedule that.

Dr. HICKS. We are not trying to bypass that problem. The question is really a technical issue here.

Mr. MCCURDY. Well, I think we need to get a briefing.

Mr. PRICE. Mr. Hertel.

Mr. MCCURDY. Would you yield for one question?

Mr. HERTEL. Yes.

Mr. MCCURDY. Can you tell us in the DSARC process or other review that any R&D item, can you give us a list of any that were actually terminated or stretched out or killed through the DSARC or whatever, from the last time to now?

Dr. HICKS. Since last time being when I came on board?

Mr. McCurdy. Yes.

Dr. Hicks. We have actually postponed several DSARCs because we felt the Services were not ready to come in and talk about it.

In fact, we are in the process now of being involved with the Army on the Forward Defense Program, and we are finding that they are not ready for DSARC. So the point I think we are talking about here is that we have had only two or three DSARCs since I have been there. We have postponed several because the Services were not ready.

We felt that they had not come to the point where they could come through DSARC and get through. Generally the DSARC you know it is like, from my military days, what a military trial used to be like. The decision was made before the court martial. The court martial was just for fun.

The DSARC requires a lot of data. If the data isn't there, we have to assume that we can get that data, and when we don't like to do that, we hae pre-DSARC issues that we send back before they get to the DSARC.

If they don't agree with us, we can tell——

Mr. McCurdy. I hope you misspoke. I hope you didn't say the decision to proceed is a foregone conclusion at a DSARC regardless of the facts. I hope that is not what you said.

Dr. Hicks. That is not what I said.

Mr. McCurdy. I think you need to clarify.

Dr. Hicks. I will clarify by saying that we try to make certain that all the data that we need to have to make a proper decision in the DSARC is available to us. If it is not, we don't allow the DSARC to proceed. The fact of the matter is if all the data is available and we are in agreement with the data, we then can decide whether the DSARC will go ahead or not.

But there are very few programs that go into DSARC. We have a lot of programs that have gone through DSARC II and if you look at the amount of money we are asking for, a large percentage of that money is already in development past DSARC.

Mr. Dickinson. Will you let me ask a question, Mr. Hertel?

Mr. Hertel. All right, go ahead.

Mr. Dickinson. I would just ask, I understood you to say what Mr. McCurdy thought you said. Did you say that when you have a DSARC, if the answers don't—if the information is not like you want it that you send them back to bring back in the right answers?

Dr. Hicks. No, that would be great if we could have them do that. The fact of the matter is we hold pre-DSARCs and we find out whether they have the necessary information. If the necessary information is not there, we send them back. And they have to go back and meet the requirements of the DSARC. If they don't meet the requirements of DSARC we don't hold the DSARC.

Mr. Dickinson. Thank you, Mr. Hertel.

Mr. Hertel. The only thing good about being last is I don't have to worry about the next person, I guess.

Let me talk about some of the things I agree with you that you emphasized in your opening remarks, Mr. Secretary. That is that we have to have a higher priority and that is expensive on conventional forces.

I agree with you. I am glad to see you espouse that viewpoint so well. I share your frustration on the matter of the 50 MX missiles. I could argue for over 100 and I am one of those that supported 0, but 50 I can understand your frustrations with. It is impossible to explain; 50 makes no sense. It is a political compromise, although I clearly don't see it being raised.

I disagree with you when you talk about your concern of too much oversight, or micromanagement. The reason we get into things like JSTARS is not because we get a kick out of it. It is because we sit here for 20 years for some Members and 5 for others and see we cannot reach common sense agreement.

It is our responsibility. There is no way that personally or in our elected Government that we can tell people that it is not our responsibility when they ask about what is being spent and what are the objectives.

Dr. HICKS. I don't deny that, the point is there is something that Senator Nunn said in a recent floor speech in which he talked about. I am used to having a group over me called a board of directors, and they give me policy and if I don't do my job, they fire me, and they should fire me, and people have different areas of responsibility.

You all have the power to do anything you want to do and if you want to in fact manage and micromanage the Defense Department as duly elected representatives of our people, that is your right to do.

What I am saying is it is not the most efficient way to run things. I am not saying that DOD is without fault or that people don't make mistakes, or that everybody over there is great and so on when they are not. They are not all great there, they are not all great in industry, and they are not all great in Congress. We all, I believe, share that fault.

But the only way that you can get things done, whether it is in the military, defense, or industry, is to assign responsibility and let the people do it and make them responsible.

We have a desperate time in this Government finding out who is responsible anymore for anything. When mistakes are made, you cannot find the responsible person. When somebody leaks information that you know is superclassified, you cannot find the person. No one can ever find anybody that does anything wrong. Nobody ever gets fired.

Senator Nunn said last year that Congress made adjustments to more than 1,800 separate programs in the Defense Department and it required over 400 to 500 pages to explain why we did it.

Now, I don't mind things coming over in conference language that says, "We think you should do certain things." But when it tells me that moneys going into a program that we have decided who will manage it, will now be managed by somebody else, by the way not the Secretary deciding who, but by name somebody else, and that it will be done for specific comparisons between two weapons systems when good technical people will disagree that that is possible—that, I think, is bad management.

It may be in politics but it is bad management.

I resent people in the Department of Defense frankly, who use that approach to bypass the capabilities of management of the people over them. You cannot run things this way.

I believe that it verges on anarchy. If the board of directors of a company acted that way, it would be impossible to manufacture anything.

So I don't deny your right, I don't deny your power. I say, we are all in this together. The problem is the Soviet Union, not anyone else, and what we have to do is to find ways to get this issue back to where we can manage it properly.

I think it is virtually impossible to do that the way things are being done. And Congress bears a major responsibility in that problem, and we certainly bear some responsibility too.

Mr. HERTEL. I agree, there are certain things Congress does where they do dictate the wrong way and even some of the Senators do.

But as cumbersome as the system is, we do have that responsibility, and that is going to remain.

I agree with you, we have to change the system and improve the system very much so, not only here.

Dr. HICKS. But over there, too. I am not denying that.

Mr. HERTEL. We don't want to debate JSTARS to a great degree.

Dr. HICKS. It is a very important program and when we have our meeting together, I can absolutely make you understand what the problem is in JSTARS.

Mr. HERTEL. We can have that meeting and debate it in a classified session, but the fact is we were involved because things weren't happening.

Dr. HICKS. No; they were happening, but the feeling was that they were not.

Mr. HERTEL. But the feeling was here they were not.

Dr. HICKS. They were happening because I was heavily involved in what was happening, and I know they were happening. I have spent as much time on JSTARS in my 6 months in the Department as on any other program, probably a factor of three times as much, including checking out what was going on with the contractors and putting in time with the Air Force.

The original problem was to even get the program on its way. It was a very difficult time for both the Air Force and the Army to agree to start the program that we finally were able to put through.

I personally spent an incredible amount of effort on that issue.

Mr. HERTEL. That is exactly the problem—cooperation. That is why we got involved.

Dr. HICKS. We have a program and it is going to be all right.

Mr. HERTEL. It is an ongoing problem of cooperation, but let me get specific.

Do you think really that you have sufficient staff to carry out the requirements of Public Law 98-94? Is 15 people enough to oversee 150 weapons programs, to monitor them correctly?

Dr. HICKS. Let me just say that our people are pressed, there is no question about it. They have been pressed because of decisions made in Congress regarding cutting back on the DOD staff.

I would like, for the record, to give you a comparison of how many people work for USDRE now, and since reorganizations have occurred. I will try to consolidate all of the facts for the purpose of comparisons as compared to 15 years ago when I think DDRE was in its highlight of making impacts and impressions.

I am convinced the staff that we now have in USDRE are absolutely equivalent in capability of what we had 15 years ago. I am very proud of the personnel who have come into this situation.

Mr. HERTEL. How about numbers?

Dr. HICKS. Numbers are not sufficient. But again it is a trade I am not going to decide how they should be ratioed. That is an issue for somebody above me. All I can do is to decide what I can do with what I have and to do the best that I can. But we would be perfectly happy, for the record, to show you what has happened in numbers.

Mr. HERTEL. No; what I am saying is, I agree, you could use more people, and some of us are talking about a floor of 50. I think your work is important.

Dr. HICKS. That costs more money.

Mr. HERTEL. But maybe it saves more money in the long run.

Dr. HICKS. If I may, I apparently made a mistake in what I said. I somehow said that the Gramm-Rudman helped us. I didn't mean to.

Mr. HERTEL. Nobody else has said that.

Mr. MCCURDY. Nobody else said that. That was a surprise.

Mr. HERTEL. A lot of us do feel that way, and we will try to give you more personnel in that area. It would save money in the long run.

Dr. HICKS. Mr. Dickinson asked a general question in line with what you are discussing, and I think I had forgotten, and I should answer that. That has to do with the contacts we may have had with the Packard commission.

I want to say that I personally have had no contacts with the Packard commission as a body, except in discussions of how well black programs are managed, and how we are able to manage black programs so well when other programs are so difficult to manage.

I do know that Mr. Packard has given a presentation to the Secretary this month about their findings. I do not know what they are. I have not had access to them.

Mr. DICKINSON. Thank you.

Mr. HERTEL. Can you identify those programs that you feel are experiencing difficulty in meeting specified test objectives at this time? Some of the bad news that we have not heard today.

Dr. HICKS. It would probably be best to put that in the record, and I will do that. I don't know of any that we have any major problems with.

Mr. HERTEL. None?

Dr. HICKS. There are a lot of programs that are difficult, and they have development problems. So that, to me, is normal.

I will have to, for the record, give you a list of things where I think we may be experiencing some difficulty.

(The following information was received for the record:)

### PROGRAM TEST OBJECTIVES

The test objectives as approved by ODUSDRE (Test and Evaluation), through the Test and Evaluation Master Plan (TEMP) approval process, are considered to be achievable for all of the programs under the oversight of this office otherwise the TEMP would not have been approved and the testing program would not have begun. As the test program proceeds, this office monitors the progress to ensure that the test objectives are being met. When it becomes obvious, as a result of the knowledge gained during the testing that a significant test objective cannot be met within reasonable fiscal and financial contraints of the program, this will be brought to the attention of all parties concerned, including the DSARC principals for resolution. Currently, there are no programs that fall in this category.

Although there are no programs that cannot meet their test objectives, some are experiencing difficulties. Typically, the difficulty in meeting test objectives arise from unexpected (and usually unpredictable) events which impact either the test schedule and cost which in turn impact the weapon system procurement process. For example, programs experience late delivery of working test hardware or needed support hardware. These difficulties, in almost all cases, can be resolved with more resources; dollars of time. Examples of current programs in this category are: AMRAAM, Combat Control Subsystem MK1, M1A1 120 mm gun, and Aquila RPV.

Finally, difficulties in meeting test objectives arise from test programs which are success-oriented, that is, they do not allow sufficient time (and resources) to accommodate for test failures. Often, other factors, such as the urgency of the military need, the priority of the program, and the interelationship with other programs, require an aggressive test plan. The ODUSDRE (T&E) will report out these programs to the DSARC principals and closely monitor the progress of each program. Examples of programs in this category are V-22 and ATACMS.

Mr. HERTEL. You touched on it, but the transatmospheric vehicle, since we are talking about so far into the future with just a prototype flight in the mid-1990's—but we are talking about investment of $2 billion or $3 billion up to that point.

Considering the budget constraints, is that something we can go slower on?

Dr. HICKS. I would say it is like anything you do. You can do what you have to do. It is an enormously important thing if it works right. The numbers we have to date indicate we could put a payload in orbit for a price much less than what it costs on, for example, the shuttle.

Now, that is going to be an enormous advantage for a lot of things we want to do, whether it is in SDI or other places.

The other thing, it is of enormous military value to have a recallable vehicle that will move that fast from an airbase. It could be of exceptional value to us. I think it is a very important project with some risk. And the reason that the budgeted numbers are as high as they are is so that we can put that risk behind us early on. It is a program that I believe will be worth the money invested.

Whether, as it turns out in the priority of things, it is the wisdom of Congress that it has to be slipped, that is your decision. I think it is important. All we can ever do is to say in our budgets when we bring them over here is that we have gone through all of the requirements of the CINCs and listened to the services and done our best to try to weed out programs that are no good, and so on.

It is the DRB process. We have all had our say whether it is the Secretary of Army or me or whomever, and the people around the Secretary. We have come in with our judgments of what is needed. We try to play that down because we certainly need more than we have.

We all agree that the Soviets are moving much more rapidly than we are. Our position is as you know, that if the President's total budget is met, we won't have to worry about Gramm-Rudman.

Mr. HERTEL. I guess we will have to worry about what we are going to do if that happens.

Dr. HICKS. But whatever happens in terms of that issue, we must continue to remember that the Soviets don't have Gramm-Rudman.

Mr. HERTEL. You talked a lot about the Trident, and I am a strong supporter of the Trident. I am concerned about the blue-green strategic laser, even though it has been making major breakthroughs in recent years, that we are not speeding that up for communication use.

What is the problem there of the Navy not being more interested in moving on that?

Dr. HICKS. I don't know. I have to say that I was heavily involved in my other position in the Blue Laser Program, and that program, when I left was going very well. It is a program where my former company was supplying the blue laser for that system, and Lockheed supplied the rest of the system.

I don't know where it is. Beyond that, I would be glad to look into it.

Mr. HERTEL. Could you let me know? We would like to help in getting that operation.

Mr. HICKS. OK.

(The following information was received for the record:)

### SUBMARINE (BLUE-GREEN) LASER COMMUNICATIONS PROGRAM

The Navy has been interested in the concept of laser communications to submerged submarines for many years and has contributed to the joint Navy-DARPA technology development. A report provided to the Senate Appropriations Committee on 22 May 1985 by the Deputy Secretary of Defense contains details on the progress, agreements, and a funding plan leading to a development decision by fiscal year 1988.

However, the fiscal year 1987 budget preparation resulted in a decision to invest several billion dollars in a new airframe (E-6A) for the Navy's airborne very low frequency (VLF) relay platform known as TACAMO. In the course of this debate, the Navy expressed a preference for improvement of the existing TACAMO airframe (EC-130) coupled with some improvements to the communications equipment, and continued investment in alternative communication system technologies such as SLCSAT. But, in view of the strong commitment to the TACAMO new airframe (E-6A) evinced by congressional and OSD actions, the Navy has deferred plans to pursue a SLC system development until the period of heavy investment in the new airframe is past.

In summary, we believe that the Navy appreciates the progress that has been made in SLC technology and the profound implication to both strategic and tactical submarine communications. This progress has prompted a revisit of the issues relating to the alternative means of satisfying our requirements for survivable strategic communications within the Navy, and will, no doubt, bring about a review of our investment strategy as we build our fiscal year 1988 budget this summer.

On the other hand, the Navy is bound by previous decisions and current budget constraints to defer SLC developments as delineated in last year's report. We do not necessarily agree that deferring SLC development is optimal for the Nation in the long term but defer to the prior decisions.

Mr. HERTEL. On the small mobile, I want to clarify the discussion you had before. It did seem to me as the last member was asking you, Mr. McCurdy, that you are not a big fan of the small mobile at all, and that you are almost opposed to the small mobile as we have talked about implementing it and going forward with it.

Dr. HICKS. I am not against the small missile. It is the issue of whether that is the way to proceed in relative fashion. I just believe that we should at this point take time to determine—and I believe the answer will be positive—whether we can go to a MIRV'd three-warhead mobile missile on the same basis doing the same thing that single ICBM will do, and save the American taxpayer $20 billion.

It seems to me in terms of discussion of Gramm-Rudman and other things that it is a worthwhile saving, even if it is over a period of 10 or 20 years.

Now, maybe some of the things Mr. McCurdy says are true. There may be situations where we would have problems because the 30-psi launcher as it moves along, would be somewhat wider and heavier. It would go from 170,000 pounds total with the missile, to maybe 250,000 pounds total with the missile.

I don't think it is going to be a problem. I think that those are things that we can work around. This kind of a vehicle can go just about anyplace. If you know that desert area, as I do, where we may be putting some of these missiles, that will not be the issue. I don't think it will.

Mr. HERTEL. It is going to be a major point of debate, I am sure.

Let me just say, in concluding, that it is clear the President's budget is going no place. We know that from his own party, and because their support of it is very lax and nonexistent. Therefore, we are going to need your help in the coming months on priorities, because of those cost figures.

And I appreciate your coming today.

Dr. HICKS. Thank you, sir.

Mr. PRICE. Mr. McCurdy.

Mr. MCCURDY. I have just one other question, if I could.

Can you tell us the status of the F-15E?

Dr. HICKS. I really am not up on that. The last I heard, it was going fine. But I would like to make that response for the record, Mr. McCurdy.

Mr. MCCURDY. That is one I hope you look closely at.

### F-15E PROGRAM

The F-15E program is proceeding smoothly. Due to the program's high priority, RDT&E funding has been protected from Gramm-Rudman impacts. Procurement funding begins this fiscal year, when 8 of the total 48 F-15 aircraft buy will be E models. In fiscal year 1987 and continuing through the currently planned end of production in fiscal year 1994, all F-15 buys will be E models, resulting in a total procurement of 392 aircraft. Delivery of the first F-15E will be in December 1986 and developmental test and evaluation at Edwards will begin at the time. IOC for the first operational wing is currently planned to be June 1989.

Mr. MCCURDY. Also, on the C-17?

Dr. HICKS. Yes.

Mr. MCCURDY. That is a high priority, on-schedule program?

Dr. HICKS. Yes; it is a high priority.

Mr. MCCURDY. You will not buy more C-5's?

Dr. HICKS. That is our judgment.

Mr. MCCURDY. I agree with you.

Dr. HICKS. Congressional judgment may be different.

Mr. MCCURDY. Thank you.

Mr. PRICE. Mr. Dickinson.

Mr. DICKINSON. Mr. Chairman, I want to ask a procedural question.

After Dr. Hicks, what are our other witnesses? Will Dr. Hicks be back?

Mr. BATTISTA. We have Dr. Hicks scheduled for tomorrow morning, part of the morning, followed by his staff after that, on testing and et cetera. So we will be meeting again at 10 o'clock in the morning.

Mr. DICKINSON. All right.

Mr. BATTISTA. And for the rest of the day.

Mr. DICKINSON. I was interested in having an informal session some time, a little brain-storming session with you, Doctor.

Mr. Battista and I and the chairman were over last week, and we visited the Porsche plant, and they have an experimental or prototype of what they call the Weasel. It is a 2,700-pound, 2-man tracked vehicle. It looked very attractive. You can get about four of them for the price of one Bradley.

I am not trying to start an argument. But you have four targets covered with four of them.

Dr. HICKS. Will it hold a tow missile on each one?

Mr. DICKINSON. Yes.

I would just like to have an opportunity before our hearings conclude to have an informal session on that and other things, too.

Dr. HICKS. I would be glad to. Any time that you want me to come over, I will be glad to.

Mr. BATTISTA. Mr. Secretary, you were talking about micromanagement earlier, and even though I think your facts are wrong—certainly your perception of how things work in the conference I think underplays the role of the Members in the Senate. But in any event, let's talk a little about the MX and the small mobile issue.

I think perhaps you won't get as much micromanagement if perhaps we had more consistent policy coming out of your building over there. Stop and think for a moment. We needed MX and MPS, and you had a consensus for this—this is before your watch—and the administration came in and said, "No, we don't want them in shelter or silos because they are vulnerable."

Then, lo and behold, less than 2 years later they are in silos. The explanation is we know more about hardening now than we did then. But there is no plan to put it in the superhardened silos, so that doesn't really stack up.

But we need more consistency in the story that comes over here. We had the Scowcroft commission report for which there was general consensus, and now we seem to be wanting to grow the small mobile into a basically MX junior, or at least a Minuteman III.

The facts that we get from the Air Force are, if you make it any more than 30,000 pounds—this is not my data; this is Air Force data—you lose mobility. I looked at all that data that suggests if you generate 44,000 square miles of land area and have a 20-mile-hour-dash capability, you windup causing a scenario where the Soviets have to double their warhead counted to kill 50 percent of your force.

That sounds pretty attractive in terms of putting the emphasis on arms control going to an area dispersal system where there is no payoff in building more RV's.

I think the one factor that you may be overlooking is that it is not only dollars and cents that will determine what the Congress is going to support, but the price for crisis stability. If MX costs—rather, if the small mobile costs more at the outset, but in the long term will cut down on strategic expenditures—and I don't have the clairvoyance to predict that this will be the scenario, but it appears likely—but then you have to factor in the price of crisis stability, and growing it to 70,000 pounds abrogates certainly all the Air Force data that came over here saying that any more than 33,000 we buy the farm, because every pound you add of payload adds 100 pounds of total gross weight.

So, what it amounts to is you need a more consistent story in terms of strategic modernization, and you have to put the emphasis on arms control because whether we like it or not, that is the emphasis that Congress is putting on the entire strategic modernization issue.

I don't see that happening. We have been asking, for example, how does SDI relate to small mobile? How does small mobile relate to the MX? What is the total system concept for strategic modernization?

You have not been there long enough to be able to receive that message, but I think that is the message we are sending over there.

Where are you going?

Dr. HICKS. I don't want to argue the point. I think there are a lot of things that you say that are right. I may disagree with some of the things the Air Force told you. For example, they seem to be very interested in having 37,000 pounds instead of 30,000. I don't see anyone telling me it is going to affect their dash capability.

I think that perhaps we have a technical disagreement about these facts, and that is something we will have to go through the data and determine the correct way to go. My belief now is that we will not hurt the dash capability as much as it appears to you from reviewing the Air Force data. But those are things we can certainly find out. We can get to the bottom of that situation easily.

The implication from arms control, which is essentially how much of their SS-18 force has to be stacked up in terms of going into that area, which is all designed to produce a deterrent in the first place, will not be impacted if we don't affect the dash capability significantly by making the thing heavier.

I think the issue that we have to address is a technical issue that is easy to resolve. We can find out which is correct and when that answer is provided I certainly will buy it.

The issues of what came out of the Scowcroft commission, I thought I said initially that I think the administration is going right along with that. In fact, in their budget they talk about things right in line with that. But I don't see that—even though there may have been, as you say, offside discussions about how many MX and so on, as far as the administration, as far as anybody saying to me whether it is in the National Security Council or anything else, there has been a real desire to go to the 100 MX's.

As far as superhard is concerned, I am not the greatest fan of superhard in the long, long term, either. I just think that is a basing mode that gives us a tremendous improvement over the MX silo, a major improvement.

Mr. **Battista**. Again, that is temporary.

Dr. **Hicks**. It could be, based on whether or not the Soviets really get to a point where they can attain the kind of accuracies that they need to make that a problem. We are giving them capabilities they don't have, at the present time, and whether they will have it or not in the long term we don't know yet.

But I have no preconceived notions of what is right or wrong in this situation. I want the best land-based deterrent. If it turns out that the single small ICBM is worth the $20 billion difference, for the reasons you state, I would be the biggest supporter in the world for it. I am not convinced now that it is. I think it is the opposite. I think we can have all the things that we need, and that we want to have, and save a lot of money by going to a different missile. That is all.

Mr. **Battista**. When do you think Congress will get a plan?

Dr. **Hicks**. Pardon?

Mr. **Battista**. When do you think the Congress—you will be ready to present an overall plan to the Congress?

Dr. **Hicks**. Clearly when something like this comes up as a task, and it is a fair change of policy. We will have to review it. I would hope that we are going to work on that very hard now to give you some idea of what we would like to try.

My belief is that we will have to spend some time gathering data. It may take a few months just to answer some of the questions that you correctly brought up. And when that research is completed, you will be welcome to review the data.

Mr. **McCurdy**. The point I have, though, Mr. Secretary—and I was on the west coast, for a week in December, looking at it, too, and I had concerns whether there were any technological hurdles that we had to overcome. And the Air Force assured me that with the more stripped down version of theirs, or one other guidance system that is in competition, that with the launcher that is already tested, and a scale model, that they are going with the upscale model now; that we are talking about being able to move into the system fairly quickly, and that the options they were facing as far as Garrison versus On Alert, and all the other different versions, that they can reduce the cost, O&M costs of the system.

And I am constantly amazed that all of a sudden critics are using the high dollar end of this system when it appears we have one that has broad-based support within the Air Force, has broad-based support in the Congress, and that appears to be moving in the direction that this Government has been advocating since the seventies when we asked the Soviets to get out of the holes and go mobile themselves.

Why the delay now? The Deutch commission came out for it.

Dr. **Hicks**. The Deutch commission has not issued a report yet.

Mr. **McCurdy**. Well, the initial reports I have heard—and through rumors, was generally they were going along with the small or at least the single warhead.

I am surprised at the interference all of a sudden.

Dr. HICKS. No; it is not a question of interference. It is a question of assuring that we are looking at the thing totally right.

I would say that any time that something looks like it is going to go, it has an advocate, the Air Force generally will be a systems manager of that, and it is instantly its greatest rooter, and he has all kinds of guys lined up to say things. We know that. That is one of the things you have all complained about, is you get people behind things that don't then intelligently look to see if it has got problems. They just want it to go, to succeed.

And I can find at the same time whenever I come up with a program, I can find corporations who believe they are going to win who become incredible advocates of it.

Mr. MCCURDY. We don't want to overload it—the idea of adding deception and all these other things, and decoys, and now multiple warheads, and so on. They are the things that I thought the Packard commission was trying to get away from. And we are trying to get away from additional requirements ad infinitum. And all of a sudden we end up with a much bigger, costlier version, and that defeats the original plan.

Dr. HICKS. If that were true, I wouldn't be for it, either.

What I am saying is you will end up with a bigger, much less expensive version, or I wouldn't be up here talking about it in any way.

The issue of whether or not you add another 7,000 pounds to the small ICBM and make it, therefore, able to penetrate, I think is very critical.

Mr. MCCURDY. I don't think Congress will balk at the 7,000.

Dr. HICKS. No; they won't.

Mr. MCCURDY. It is the doubling that gets the Congress nervous.

Mr. PRICE. Thank you very much, Mr. Secretary.

The subcommittee will recess until 10 o'clock tomorrow morning when the witness will return.

Dr. HICKS. Thank you, Mr. Price.

[Whereupon, at 3:50 p.m., the subcommittee recessed, to reconvene at 10 a.m., the following day, Wednesday, February 19, 1986.]

# DEPARTMENT OF DEFENSE REQUEST FOR AUTHORIZATION FOR THE FISCAL YEAR 1987 RESEARCH, DEVELOPMENT, TEST AND EVALUATION PROGRAM

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House of Representatives,
Committee on Armed Services,
Research and Development Subcommittee,
*Washington, DC, Wednesday, February 19, 1986.*

The subcommittee met, pursuant to call, at 10 a.m., in room 2212, Rayburn House Office Building, Hon. Melvin Price (chairman of the subcommittee) presiding.

Mr. Price. We may just as well get started and we will complete our questioning of Dr. Hicks.

After that, we will have our next witness who will be Dr. Krings, Director of Operational Test and Evaluation.

Any further questions of Dr. Hicks?

## STATEMENT OF HON. DONALD A. HICKS, UNDER SECRETARY OF DEFENSE FOR RESEARCH AND ENGINEERING, DEPARTMENT OF DEFENSE—Continued

Mr. McCurdy. Thank you, Mr. Chairman. I just had a couple questions of Dr. Hicks, Secretary Hicks.

This morning I would follow up on some of the discussion we had yesterday and again I appreciate your appearing this morning. We will try to let you off as quickly as we can.

In our letter that we addressed to you, we were fully aware that you had not been in a position—in the position long enough or a sufficient length of time to complete or at least analyze the situation as broadly as perhaps we were requesting in that letter.

We understand that you had a hard time, you have been in your position not long enough to completely answer our concerns in the letter. But I wanted to reiterate to you and for the record again and request that as you embark on your position that you develop and work with us in developing an overall strategy, a roadmap or whatever you would like to call it for R&D, and that we become a little more aware of what your concerns are in the long term as to how R&D is managed, how it is integrated, and the reason I state that is because I just left my other subcommittee where we are considering reorganization of OSD and DOD and strategy and overall policy still are key considerations.

I think what we are trying to do, to ask of you is to try to build a conceptual architecture or framework in which this is all presumably driven, and we are still back to the question, what drives the policy, the technology or the mission?

I am not sure it is a chicken and egg thing, I think it is one over the other. We would like to have you back, of course, over a period of time, to see if you are getting a handle on that particular aspect of your job.

Second, there was one, a report which I didn't see, maybe the staff did, "20-20" evidently did a piece on Aquila, which is one that this subcommittee last year had some concerns over.

As a matter of fact, this member had a supposed trial run out at Fort Sill in my district with the chairman of the full committee where they were to do a shot with an Aquila driving a Copperhead and it was a pretty sloppy show. It was kind of embarrassing for all of us because there was the full committee chairman seeing this not work and apparently "20-20" really got footage of bad performance.

I think we would like to look at that closely, also.

Dr. HICKS. I believe that we all want the same thing. We all want a strong defense, and the best weapons systems. And I think sometimes we disagree on how we will fulfill that need, but that will be improved, I believe by a lot of communication.

I intend to spend as much time as possible talking with the members and staff about how we think and what your views are on those subjects.

I certainly believe that we must have the cooperation, and I plan to spend as much time as I can working with members of the committee and the staff providing them my views about what we can do and what we should do to meet the military requirements we have.

The Aquila is an interesting program to me personally. I chaired a Defense Science Board Study on RPV's maybe 13 years ago or more, and those were the days when I was berated by the Chief of the Air Force who thought I was a member of the staff instead of an outsider for even looking at something that didn't have a man in it.

Times have changed a lot since then, and I am a firm believer in using unmanned vehicles wherever we can. The Aquila's military requirement is real. The question is in the process of meeting that requirement—have we done too many things, tried to make it do too much, and gone beyond the knee of the curve in terms of capability worth cost—and I have not had time personally to spend any real time with Aquila.

The Army as you know, postponed that program and has now started up again based on the belief that they are now able to go ahead with it.

So I will spend time on that specific program.

Mr. MCCURDY. You stated our position clearly, that is we agree with the mission, we agree with the need to move with RPV's but our concern has been whether it has gotten too loaded up trying to perform too many functions and the cost of it has gotten exorbitant.

There may be a lower cost alternative.

Dr. HICKS. Some of the matters that I think we need to look at is where we are; it is easy to say that the things were done incorrectly for a long time and therefore we should sort of punt.

There are possibilities it seems to me, regardless of the history, to look at that hardware and simplify it without starting from scratch. I think that we should take a look at these possibilities to see if we can product improve them sometimes, making some systems into lower cost issues.

Mr. McCURDY. There is only one other area I want to cover, and that was on the—we covered some of the big items yesterday. But, an area in the tactical munitions and in the SMART munitions were again something in which the subcommittee has expressed an interest, and I have been very concerned certainly, that we move forward.

This is in the area—I am trying to think of names like Sadarm and the Skeet-type thing. There are two or three different variations of what that Skeet can do and there is air-launched and artillery and all the different things.

Dr. HICKS. Right.

Mr. McCURDY. That appears to have a tremendous amount of promise. It is low cost. You can produce adequate numbers and it certainly is showing or potentially showing some effective tank-killing capability, destroying runways, and those kinds of things.

I was curious if you had an opportunity to look at those and if you sense that that is on schedule and appears to be a viable area that we can support fully?

Dr. HICKS. I am a big proponent of SMART standoff weapons in general, and have been for a long time. That includes issues like air-to-ground issues that we have played around with for 10 years we could have done a long time ago and haven't done that I had proposed a lot of times in the past.

The issue of standoff weapons is going to become more important as we go to our new platforms because certainly we don't want to expose platforms that are expensive, high technology platforms to some person with a $10 missile, and so in general I am going to do as much as I can while I am here, to promote the issue of standoff SMART weapons.

There are a number of issues that I don't think we have done enough with. For example, the cost of infrared sensors is something that would be brought down if we bought CCD arrays and there is no reason we cannot explore a lot of similar technologies. I have been briefed on the particular concept of Skeet and others, and I have known about them for some time, and of course, agree with you that they are great concepts.

I have not had time since I have been here to actually see the specific performance of Skeet to make certain that it is meeting what we hoped it would do. But I plan to get into that entire area in this next few months.

Mr. McCURDY. Thank you, Mr. Chairman.

Mr. PRICE. Mr. Badham.

Mr. BADHAM. No questions. I have no questions, Mr. Chairman.

Mr. PRICE. Any further questions?

Mr. McCLOSKEY. Yes, Mr. Chairman, thank you.

Good morning, Mr. Hicks. I would like to hear generally your immediate evaluation of development in the strategic defense initiative, the SDI. Frankly, I am very concerned in these days of Gramm-Rudman to see that the request is coming in in the area of

$4.8 billion jumping from $2.7 billion. I just don't know—(*a*) how we can afford that; and (*b*) can we expend that amount of money efficiently and I realize you are new but can you give us some idea of your thinking along these lines?

Dr. HICKS. That will be discussed by General Abrahamson, he is responsible for that program.

I have general R&D oversight on any program but he really is the man responsible for SDI. I would like him to address that specifically.

My own feeling is as I pointed out yesterday, that you cannot just say when you see a buildup like that that you can or cannot spend the money. It depends upon what infrastructure is available. I am not really prepared to answer that the infrastructure does exist at this moment.

If you note, total moneys integrated under the curve, as we say, because of the cuts this year, are less than were planned. Some of the things that General Abrahamson expected to do he was unable to do, so without being specific, my belief is that they can, in fact, spend the money and that they are going on a course that will pull together large numbers of excellent physicists and engineers and other scientists to approach the problems.

Mr. MCCLOSKEY. I would say and I think most of the committee would agree, that we have had real problems getting detailed reporting and analysis in various components of the SDI Program. We can talk about that later.

I am sorry I was not here yesterday, but I would ask you briefly along the lines of the material covered yesterday but——

Dr. HICKS. That is no problem.

Mr. MCCLOSKEY. I would be pleased to hear your rationale for doing MIRV'ing on the small mobile missile since the single warhead missile has really been a keystone in as you know, the MX and arms control committee resolution which has been very successful in the Congress and the administration.

Dr. HICKS. Let me try to summarize my beliefs in that area. When the Scowcroft Commission report came out there were certain conditions called for, one of the conditions I know about, although Mr. Battista said yesterday there was an agreement, unknown to me and in my checking, unknown to the administration as far as I can tell, that 50 MX's were called for, not 100.

Now, when that Scowcroft Commission report came out as far as I know with the requirement for 100 MX's in Minuteman holes, I think that kind of deterrence, which is rather cheap to get on a comparative basis is something that is still important to discuss. As Mr. McCurdy said yesterday, there is a political consensus that we could have 50. My instructions have been to pursue not only the attempt to get the next 50 MX's but also to work on the basing modes to make the 100 MX's more survivable.

Mr. MCCLOSKEY. If I could ask you, excuse me, you are saying the administration does not accept the congressional understanding of 50?

Dr. HICKS. They accepted the understanding of the Scowcroft Commission as far as I am concerned, that they were to have 100 MX's. Now we hear within the last year-and-a-half or year that suddenly we cannot have the remaining 50, and, as I said yesterday, Mr. Battista in rebuttal to me pointed out that in meetings he had had with the commission, that there was tabled an agreement that was for 50; that was all that was supposed to be there. I checked that out with the Secretary this morning, and it is not known by him.

So at least according to our instructions and as far as what we thought, the deal was that it was 100 MX missiles.

Mr. **Battista**. May I just point out that I didn't say that yesterday. What I said was when we were asked to brief the Scowcroft Commission, Mr. Dickinson and I went on over there and we were discussing a package. We had proposed a package. It was called the Dickinson proposal. And what it contained was 50 MX missiles with a small mobile and arms control linkage. Which is essentially what they came out with.

We also talked about a zero sum deployment and at the time General Scowcroft said that is something that the Congress should put its thumbprint on. We will not touch that.

Now, when we were discussing the rationale for MX missiles, the subject of how many came up, they had indicated 50, they started talking about the political nuances and said if you really want 50, you should perhaps ask for 100, since there is no real military requirement for either 50 or 100. There is a military requirement if you believe the threat, for a larger number.

However, knowing the way things go, ask for a little more and you may get 50.

Mr. **McCurdy**. Well this is still academic. As I said yesterday, some of us agreed with the Scowcroft Commission report. But Scowcroft is not legislation.

Dr. **Hicks**. Of course not.

Mr. **McCurdy**. Congress enacted a limit which is the amendment we supported and limited it to 50 because that was the political consensus and it was impractical if not impossible to achieve a greater number.

So rather than freeze the number at 42 or whatever it was, 41, we decided that we had at least the capability to get 50. Now, it is academic to say—you can say you don't like what Congress did but in reality that is what you got.

Dr. **Hicks**. Sure.

Mr. **McCurdy**. What I am saying is let's not waste a lot of time, let's go where there is potential for support and that is with such things as land-based leg on the Midgetman and move in these directions, and try to build on what we have and come out and get the best we can. Because we are all trying to achieve the same thing and that is improving our nuclear deterrent.

Dr. **Hicks**. That is correct.

Mr. **McCurdy**. I don't see where these academic arguments get us anywhere.

Dr. **Hicks**. They are not arguments. I was just trying to explain where we are.

Mr. **McCurdy**. Well, on both sides.

Dr. **Hicks**. In the process of what was then the case and what is now the case, there are a number of changes.

The base line issue of the mobile ICBM as far as I am concerned has always been up in the air. I realize that all the plans to date are on single warhead ICBM. It has been brought to my attention over the last 8 or 9 months of what appears to be some real savings that we could achieve and that seems to be one of the jobs I think I have which is to try to find out how we meet our military requirements and save money, that we could meet those requirements by going to a different configuration of that mobile missile.

That configuration has been studied by Rand, and by the Air Force. We will have to do more studies, but I have talked to people in industry that I trust and value in terms of their understanding of the problems and in general, they believe that we could have a three-warhead missile, mobile, with a 250,000-pound vehicle.

Now, the question really is, is that a good tradeoff? It would appear to be about a $20 billion savings, and could still meet other requirements in terms of being able to charge a high attack price.

This is an issue we would like to raise. If you are really talking about saving money, if you want to do what you say you want to do which is to have a mobile missile, we ought to consider whether or not the MIRV'd three-warhead missile is in fact an appropriate way to do the job.

That is all. Nothing more than that.

Mr. McCloskey. I would assume there would be a widespread congressional consensus that that would substantially eliminate the rationale for having a small mobile missile to start with.

Dr. Hicks. I don't quite understand that statement because in fact, the main reason we want to do this, the big reason, was to have a place to put these missiles into what would require large numbers of SS–18 equivalents to knock them out. That has not changed one iota.

If you are suggesting there is an inherent arms control advantage to mobile single-warhead ICBM's, then I see no sign of anything happening on the other side that would indicate that that bears any fruit at all.

In fact, the SS–25 which is their mobile missile could easily be MIRV'd to a three-warhead missile.

Mr. Dickinson. Will the gentleman yield.

Mr. McCloskey. Yes, I yield.

Mr. Dickinson. I don't know if it would be helpful or not, but I just want to review the bidding with you. I cannot dispute what you say about the efficacy of putting, doubling the size or a little more and putting three warheads on it. But how we got to the position of where we are now is that we had a large body of Members with the sentiment they didn't like the MX, that it was a sitting duck and as the Soviets improve accuracies and so on, we couldn't harden against it, and they did believe in a mobile missile.

Some didn't want any at all, and believe it or not, there was even some linkage between that and the chemical munitions. So in the give and take of a—of what was in the realm of the possible, we came to what we arrived at, finally came out of conference and that is the small mobile with a single warhead, and some of the opponents I guess of ICBM's in general, they wanted to limit it to 30,000 pounds, make sure that there wouldn't be but one warhead on it for whatever reason.

I am just speaking from recollection here, and somebody else can correct me, but we got an agreement from some of the people that were interested in chemicals and some were opposing it and so on, and we said, you know, we are interested in this other thing, too, and then we came up, presently Senator Gore but then Representative Gore, was one leading the fight for the small mobile.

There was a large body of supporters for the small mobile. Some wanted to make sure it only had one warhead so it was limited in weight, and I with other supporters of the MX said, hell, if that is what it takes to get the MX, we will go for it.

So they wanted to limit the number of MX's to 40 or 42 depending on how you count the test vehicles, and we wind up with 50 with the give and take of it.

You might be right on your numbers, on weight and throw weight and dollars and so forth, but if we reopen that package then it is going to be Pandora's box because all of them will be coming out and we will be fighting the battle all across the frontier.

This is my opinion. I would be glad to yield to Mr. McCurdy or anybody else.

Mr. McCURDY. If the gentleman would yield, I think the gentleman stated it perfectly. The question I have, Dr. Hicks, are you citing a study? Is there a proposal that has been submitted on it?

Dr. HICKS. No, the fact is that if we proceed without saying something at this point, the thing is locked in. It was our judgment to at least bring the issue up. We have conducted some studies, these are not off the wall suggestions. It is possible physically, to go. It has some problems compared to the smaller missile, but it also has some advantages.

Some of these advantages even can be basing advantages. The point that I want to make is that I do not in anyway want to preclude good political judgment about what we do, Mr. Dickinson. I recognize the world quite well. I have lived in it for a long time.

On the other hand, I have a responsibility to bring up the best technical solutions at the least cost. If it is decided that that solution which I believe could save $20 billion of the taxpayer's money is not the way to go and it is not politically the way to go, then that is fine and I am not going to stay awake nights worrying about it.

I have a responsibility, however, to at least bring up the issue.

Mr. McCURDY. What we would like to see is how the numbers were arrived at because the numbers that I have seen, and there is a lot of give and take on whether you are going a garrison approach or other, and what areas of the United States that you deploy them in, there are a number of considerations there. I think there are ways to drive down the costs and still keep the Soviets' price to kill those so high that it makes it extremely effective as a deterrent.

Dr. HICKS. Whatever you do I think you will find there is a bottom line that we have known for a long time. In fact, the reason we went to MX's was that reason, that when you put more warheads on a given vehicle, it is more efficient and saves money.

Mr. McCURDY. From an offensive targeting capability, but from a defensive, the targeting problem that poses the Soviets, if you have a smaller system that is more readily deployed, you have a larger number of them, that raises the Soviet price to kill to such an extent that it is a good deterrent.

Dr. HICKS. Not necessarily. If you assume that the Soviets cannot target your missiles because they are mobile, which is the assumption of the small ICBM deployment, and therefore have to barrage the area, when you run through the mathematics and it doesn't make any difference whether you have 500 single small ICBM's in that area, or 170 three warhead small ICBM's they don't know where they are.

So they have to barrage the entire area and it takes exactly the same number of SS-18 equivalents to kill those missiles.

Mr. MCCURDY. That is the numbers I would like you to submit.

Dr. HICKS. Absolutely.

Mr. MCCURDY. If you have a study or some report or something.

Dr. HICKS. That one is easiest of all.

Mr. MCCURDY. I would like to see that.

[The material requested is classified and retained in subcommittee files.]

Mr. COURTER. That is an area that I had heard of before. Are you saying you have a study on that or you will supply something for the record?

Dr. HICKS. I would think it depends on your definition of study. There have been a lot of thoughts given to this issue and there have been people who spent time making trades and so on. It is not what I would like to say is a definite detailed engineering design done on this situation.

I think that within a couple of months we could have a very detailed discussion on comparison of the two issues in terms of vulnerability and cost.

Mr. COURTER. I would hope you would. Also in respect to that, because I have heard the argument in favor of the one warhead missile, that if you increase the weight to put two, three, four warheads on it, it will not be able to go into the same area because of the weight restrictions, you have bridges to go over and roads cannot support it, which limits the area.

Dr. HICKS. You must remember that the footprint weight is what you are looking at here, and of course that is one of the things we will have to look at. We generally find easy ways around that problem, Mr. Courter. I think that we can give you some good answers there.

Mr. DICKINSON. Let me reply to one other thing that you said, and I don't doubt everything that you say is true and when you say that the Secretary, Secretary Weinberger I assume you mean, that he was unaware of any agreement spoken or unspoken to reduce the number from 100 down to 50, that is probably true. But after the conference and after we got back to the floor to get the conference report ratified, it was less than 2 weeks I believe, Secretary Weinberger is quoted in the press as saying that he is considering asking for a supplemental to get the other 50.

Well you cannot imagine how upset some of us were that we tried to put this fragile package together to get the thing passed on the floor, and here is the Secretary out saying, I don't acknowledge that, we are going for the other 50.

So I called him and explained it to him as best I could in my tactful way, and he is aware that there is a tacit agreement at least to, was, to get the bill through last year.

Dr. **Hicks**. Of course then that is true.

Mr. **Dickinson**. And he came darn near unravelling it and if we persist in this way it will be even worse trying to get the next bill through.

I would hope you take that word back to him and the next time I see him, I will try to explain it to him, too.

Dr. **Hicks**. I was quite aware of what happened last year. I realize the issue of the agreement on 50 but there was also an agreement that if we found the right basing mode, we would be allowed the other 50. It was a general statement.

I recognize what a lot of people have told me what happened, but in terms of what we were really told officially, is that if we found the proper basing mode we would be allowed to have the next 50 MX's.

Mr. **Dickinson**. I think that is something that might have been said between the Rose Garden and the Senate, because we were never included in those agreements.

Thank you, Mr. Chairman.

Thank you, Mr. Secretary.

Dr. **Hicks**. I will certainly take your message back, Mr. Dickinson.

Mr. **Price**. Mr. Battista.

Mr. **Battista**. I have a request, Mr. Chairman, and that is you are talking about a 75,000 pound, three MIRV'd Midgetman and we are a little long on corporate memory when we go back to the Air Force days and again, Mr. Dickinson and I think Mr. McCurdy was involved in some of the discussions with the Secretary of DR&E. That 30,000-pound number was not an arbitrary number. That was done with Air Force concurrence.

The story, and I wish when you put together your $20 billion figure you would include some of these factors, the story back then went something like this.

If you go over 130,000 pounds of gross weight, then you cut down on the area of mobility, the dispersal area. The bridges, you need special permits and I am talking not in time of war but in time of pre-alert, for example.

I am just giving you your—you are smiling, but I am giving you what the Air Force was giving us. All that rationale about footprint, was all factored into the equation.

If you recall there was a 3,000-pound margin added to the Midgetman where Chairman Aspin at the time said if in fact it becomes absolutely essential to go to 33,000 pounds, you come back and tell us. That has never been done. They have never come back and said we cannot achieve our mission with that objective.

All the numbers I have seen, you talk about the $20 billion savings, I would wonder, for example, when you look at the price for crisis stability, if you are factoring in the fact that you are talking about 170 vehicles in a very small area as opposed to 40,000, 50,000, or 60,000 square miles of area where——

Dr. **Hicks**. We are not talking about anything like that.

Mr. **Battista**. You said the cost of 170 would be $20 billion cheaper than the cost of 500 of the smaller ones if I remember.

Dr. **Hicks**. That is right. I am not talking about the basing area. The basing area would be the same.

Mr. **Battista**. How would the basing be the same when you consider the old Air Force argument that if you get over 30,000 pounds you are severely constrained?

Dr. **Hicks**. I don't buy the old Air Force argument.

Mr. **Battista**. What I am asking is when you go back and generate the analysis and come up with the $20 billion we would hope you factor in the arguments they used with the Congress to support the 30,000.

Dr. **Hicks**. I will. I recognize it is hard if you have a phenomenal memory like you do to live with all these changes. The fact is I don't believe those numbers are right. The other matter concerning the 130,000 pounds, came up in the discussions I have heard by the Air Force and in front of the Deutch Committee.

If you remember that.

Mr. **McCurdy**. In the legislation we allowed an increase not to exceed that. We knew there would be a fudge factor and we didn't want to micromanage it all the way.

Dr. **Hicks**. The Air Force said they needed the 7,000.

Mr. **McCurdy**. We gave them the 7,000. That is not the issue. I would like to see your assumptions on the basing mode.

Whether it is old Minuteman silos or garrison or whatever.

Dr. **Hicks**. That is fair. I want to go back to my original statement. I think we all want the same thing. I believe at this moment technically that it is possible to have a MIRVed 75,000-pound missile that will do the same basing actions that we can with the small ICBM.

That is based on factual data that I have received from people I trust.

Now, we have to do a lot more than that. I concede that.

There are details that we have to get and I will work diligently to try to get those numbers for you. I want to point out, however, once we start the development of that missile, and we have all of the adherents we always get on any weapons system, both political, industrial, and within the services themselves, we will have a difficult time making this kind of evaluation. If we are going to make the evaluation it has to be done now and if the evaluation says I am wrong, I am perfectly willing to admit it.

I have been wrong before.

Mr. **McCurdy**. Are you suggesting we delay?

Dr. **Hicks**. I am not suggesting anything except that we will be working hard in the next couple of months to resolve this matter. I will say this, that if it turns out that we have to—we as a group, decide which obviously you are as I say the 500-pound gorilla in this act—we will probably have to delay the research and development program by about a year.

You should expect that. That brings up the question, is it worth delaying to save $20 billion for 1 year, if everybody concedes it is the way to go.

Mr. **McCurdy**. Or to have a program or not.

Dr. **Hicks**. That is another question.

I realize that I have a hard time buying fragility. I have trouble accepting the reality of the political process although I know it very well. I really believe that there are a lot of intelligent people here and that hopefully they will look at the issues individually, and that when we have good arguments that make sense, that people will listen to them and not throw up their hands and say that we have been through this before.

Mr. DICKINSON. But a lot of them don't want to be confused with the facts, because they have their minds made up.

Mr. PRICE. Mr. Secretary, on page 27, section 4 of your statement, you say that the triple LGB has gone into production. We were advised that it was killed by the Secretary earlier. When did this situation change?

Dr. HICKS. I am going to have to answer that for the record, sir.

[The following information was received for the record:]

LLLGB

The LLLGB is now in production and we are taking deliveries using FY85 appropriated funds. We will be procuring about [deleted] weapons. The original plan was to procure at least ten times that many; however, following the FY86 Budget request, the AF terminated further procurement.

Mr. PRICE. Mr. Battista.

Mr. BATTISTA. Also on page 1, section 1 of your statement, Mr. Secretary, you talk about today as a result of the administration's judicious application of increased resources for defense, our forces are more capable of deterring aggression because of force modernization achievements and high leverage capability.

That is not entirely clear from the data we have been getting. Mr. Dickinson, Mr. Leath, Mr. Hefner, and myself, were out to EUCOM this past week and we asked there if the Bernie Rogers, General Rogers tripwire strategy, and he testified before this committee, with the current situation in NATO—this was 1982, with the current situation there—the quantitative disparity and qualitative improvements made by the Pact forces, that he had a tripwire strategy in effect which would require him to either surrender or go theater nuclear after a few days.

We asked last week, this is last Thursday, at EUCOM if that tripwire strategy was still in effect, and the answer was yes.

We were in Korea last year and we talked to the Commander of Korean Forces there and we still have inadequate number of load outs for missiles, the technology has still not gotten there, although some of our technology found our way into North Korea, strangely enough.

But I am having a difficult time resolving how all of this application of resources for technology has made our defense profile a lot better.

I am looking at a POM strategy by the Army, 1988–92. I will give you a quote from the Army Science Board. In 1979 the conclusion of the Army Science Board was the Soviets have acquired quantitative and qualitative advantage in most fielded Army systems.

In 1985, they conclude, no hope of matching Soviet land forces capability. Unlikely U.S. superiority by 1990. United States appears to be falling further behind.

When you go out to the field and when you look at Army reports and their strategy for 1992, which by the way also goes on to say that at the current rate we are falling further behind. This was October 1985.

I would wonder if we can be specific in showing how this application of increased resources has given us technology that makes our forces more capable of deterring aggression as is stated here on page 1.

Dr. HICKS. Yes; I think it is easy to do that. That doesn't say that we are not falling behind, because we are not in any way. But if we are talking about what good the increased budget that this administration has given the services to improve their capability, that has a tremendous impact.

You need to spend some time in the field with TAC and have the commander of TAC give you a discussion about how much better off TAC is today than it was 5 years ago in terms of readiness, and in terms of its ability to put airplanes in the sky.

I went to Fort Campbell and Fort Knox 1½ years ago. I go into the field occasionally. While I was there I had the pleasure of sitting in an M-1A1 tank and firing five rounds of 120-mm ammunition. I haven't fired a weapon like that for a long time.

In the field I spent 10 minutes in a unit conduct of fire trainer [UCOFT] and I had four out of five kills when I fired at real targets with a moving tank. Now, that 120-millimeter tank gun is an improvement, it is there, it is being retrofitted and new M-1's are going to have it. You look at what we are doing in terms of night vision devices, go down to Fort Campbell and see what they are doing there.

I was in Fort Campbell 1½ years ago as a result of chairing the Defense Science Board study on urban warfare. I gave presentations throughout our commands in Europe on that subject, and without exception they all felt that they were in better shape now, considerably more so than 5 years ago.

You are bringing up an issue that has to do with where are we compared to the Soviets. The Soviets are expending a tremendous amount of effort to swamp us at some point, and we are worrying about Gramm-Rudman.

They have a man now heading their nation who was brought up through a system that requires an incredible manipulative ability to get to that top office, not a fighter in the fields of communism in 1920, a sophisticated person who had enough intelligence and manipulative ability to go through that incredibly tough system. That is the kind of a guy we are facing now, and we are listening to what they say. We are listening to all these nice words. In the meantime the Soviets are continuing to build at an enormous rate.

We have to depend on our technology. In terms of Stealth, for example, we are going to set them on their rear end because if they want to deal with that, they are going to have to spend an incredible amount of money to handle it. It is not a soft science; it is a hard science.

So we are doing things, doing things well—we are doing a lot, and I stand by the statement because it is a right statement.

Mr. MCCURDY. Mr. Secretary, you just raised a point because the next witness is from DARPA, but someone raised an issue in the last few days whether we should be moving so rapidly into the areas of ATB, Stealth, those kinds of things, when the new aircraft that the President hailed so proudly the other night in his speech, that the technology leap that is involved there because of the incredible speed and flight into space and all, whether we ought to be spending all the billions and potential billions of dollars if this other technology is realizable?

I would like to get your reaction to that.

Dr. HICKS. I am not sure that we would be able to make that particular vehicle stealthy. That is one thing to remember. It would be something that I would have trouble deciding exactly its military value in penetrating, for example, on the deck or at regular altitude. We are talking about a transorbital vehicle and we are talking about doing things in space and speed.

We know where we are in Stealth. We know what we can do there. We know what it is going to cost the Soviets in terms of their ability to handle it.

It is an incredibly important leverage on them and their expenditures in defense, and it gives us an unusual advantage.

In terms of the transatmospheric vehicle, we as I said yesterday, have some work we have to do yet. I don't know that we are going to be able to develop an engine that does the things that it has to do to make that vehicle work.

It is going to be 2 or 3 years of work before we know that.

We don't know that we can develop the materials we need to do it. We think that we can do all these things. Everything is very encouraging. But I for one am not willing to say there is ever going to be a transatmospheric vehicle. We don't have enough data; perhaps 3 years from now we may have enough to tell you something.

But it won't replace Stealth. It is a different concept. If it meets the promise, it can put payloads in orbit at one-tenth the cost that it takes to put them in orbit today.

I am very much in agreement with the program; however, I am not willing to say that the program should go ahead.

Mr. MCCURDY. Can you say that of SDI?

Dr. HICKS. SDI is a different issue. It is a major kind of a strategy issue that is much different than the transatmospheric vehicle. It changes the whole concept.

Mr. MCCURDY. Is the technology there either?

Dr. HICKS. We are working hard to find out. I don't know that it is there.

Mr. MCCURDY. I am just asking if you are consistent. I think you are.

Dr. HICKS. If you want to ask me whether I am sure that we can have a system that prevents, or totally secures us from nuclear weapons, the answer is I don't know. I don't know because we don't have the research behind us. It is farther away than TAV in terms of us knowing that.

Mr. BATTISTA. I think the issues are certainly analogous, though. I think Mr. McCurdy is right. When you look at SDI, for example, 12 years ago we were working on mosaic sensors, and the objective was to put a constant-times-ten-to-the-sixth detectors in a focal plane array, so we could do launch characterization, for example. The objective was a 25-cents-a-copy detector.

The closest we got was 2,500. Yet that technology is back under SDI. I am not arguing with the fact we should undertake it. I think we should. But you have to ask, what has changed?

If the Soviets go to contact fusing you will have a devil of a time to produce microelectronics capable of living in a thermonuclear environment. So you have the same problem there. You have the cost, you have technology. I don't think it is a mistake to embark on the hypersonic or transonic plane. You are talking 10 percent of the total shuttle gross weight to carry the same payload.

That is certainly attractive. But I think when you consider the problems in SDI they are no different than in the transonic.

Dr. HICKS. It is really a subject for a complete hearing.

Mr. BATTISTA. But your predecessor said it was equivalent to five Manhattan projects.

Dr. HICKS. My predecessor is not me. I don't know what the number is. We don't know enough yet to get that number. What we know is there is a lot of incredibly interesting research that could lead to major advantages in our ability to have very strong defense capabilities.

Mr. BATTISTA. Sure.

Dr. HICKS. We know that.

Mr. BATTISTA. Sure.

Dr. HICKS. As I said yesterday, we have had these kinds of programs going on at a slow rate for a long time. What SDI does for us is to allow us to make it into a Manhattan-type project. We can put incredible teams of people in. I have seen this in my lifetime multiplied incredibly into answers we never thought we could have.

SDI is a research program. It does not violate the ABM Treaty. The fact is we are specifically careful that it doesn't. We are working hard to get the research behind us and we are spending money in high-risk areas with high payoff to get there. So I say the payoff there is more important to us by a large factor than TAV. They are both important.

Mr. BATTISTA. Let me say one other thing on the Stealth. I think you might be a little premature. This is a judgment call in the confidence we have in it. I can remember the first Stealth effort we started back in 1959. We learned a heck of a lot since, but it wasn't but 3 years ago we ran tests of one of our sensors against the very low cross section object, and found we picked up the low cross section object at twice the range, because we didn't account for the constant false alarm rate algorithms, and it was a piece of cake to get the skin track because there was no clutter.

There should be no regrets of having undertaken Stealth, I think you are right about the Soviet investment strategy. I don't think we ought to sit back and be complacent and assume that it is going to do everything we think it will do.

The other unknown is what the Russians are doing in Stealth. You never know until it is fielded.

Dr. HICKS. If they do field it, it won't have the same advantage to them as it has to us because we, generally speaking, have to now face the fact that we have really spent hardly any money on air defense in this Nation for a long, long time, and the Soviets have spent about 125 equivalent billion dollars in terms of their activities.

So Stealth in terms of deterrence, in terms of us being able to penetrate the Soviet Union compared to them penetrating us, is a tremendously more important issue for us than for them. I am sure you agree.

Mr. BATTISTA. Oh, yes, yes, no doubt whatsoever about that, but on the last point I would like to make, that is getting back to your statement here, it is not really apparent when you go to the field that they are any better off today than they were 3 or 4 years ago. I appreciate what you are saying about the technology advances that were made, but I am not being facetious or contentious but we are not going to fight the war at Langley.

What is important is what the guys in Korea have, what EUCOM have, what the guys have in the Central European theater. The situation was portrayed to us the same way as 3 years ago, and that was given to us last Thursday.

Dr. HICKS. I think you talked to the wrong guys. The fact of the matter is——

Mr. BATTISTA. Then you better replace some generals over there.

Dr. HICKS. The fact of the matter is you asked a question about tripwire. I don't deny we will be forced to go nuclear early and that is because we don't have the conventional capability to meet the Soviet threat yet, although we are getting much, much better in capability to meet that threat.

The things we are doing. Take MLRS, you are a supporter of that. That is an extremely capable thing and it is now going into production. That is another thing that will be there to help. The ATACN is ready to go to DSARC II and that will add capabilities. We are trying to do something with JSTARS. There are all kinds of things going on, some of which won't come to fruition for some years, that will improve that situation considerably.

As far as TAC is concerned, when General Russ talks about their capability to mount sorties, increase the sortie rate, it is there everywhere. He can do that in Europe, too. It is the airplane, the maintenance, spare parts, the whole issue. I would like to have this committee have General Russ come in and give the presentation on exactly what has happened in the Tactical Air Command in terms of its capability over the last few years, and how much it has increased.

Mr. PRICE. Any questions?

Mr. COURTER. Yes; I have a couple of questions.

I am back to the Midgetman if you would.

Is there anything you can say in open session—we are obviously in open session—about the Midgetman of 30,000 pounds having the proper penetrability?

Dr. HICKS. Penaids?

Mr. COURTER. Not penaids, the ability without penaids at 30,000 to penetrate.

Dr. HICKS. Clearly the Soviets have at least we know in the Moscow area, a true ABM capability and we have suspicions of a lot of things they are doing that we cannot talk about here, but just to say it is going to be more and more formidible.

It seems to me it is going to be more and more difficult to assume. We have to make assumptions based on what we need for deterrence, that they will be unable to stop a bare nose cone coming in without help.

Mr. COURTER. Is it assumed the small missile, the weight will have to have to be increased, or is that——

Dr. HICKS. I didn't get that.

Mr. COURTER. Is it assumed that the small missile's weight will have to be increased?

Dr. HICKS. I think there has been discussions with Mr. Aspin, that the weight of that missile might go to 37,000 pounds in order to do the kind of things we should be doing to make it ready in that issue.

Whether that has been discussed with the entire membership, I don't know. I think there is general agreement that there would be no real heartburn going to 37,000 pounds.

Mr. COURTER. Mr. Chairman, I move we go into executive session.

Mr. PRICE. Does the gentleman have questions involving national security?

Mr. COURTER. Yes; I do.

Mr. PRICE. Without objection, we will go into executive session for 20 minutes.

[Whereupon, at 11 a.m., the subcommittee was adjourned, and proceeded to executive session.]

Mr. PRICE. The subcommittee will resume its hearings.

Mr. COURTER. Mr. Chairman, I appreciate the ability to go into executive session for a few moments. We can speak more frankly about Midgetman missiles.

What prompted my question, I saw a classified report—I don't know the date of it, I don't recall the date of it—that showed that [deleted] the type of defenses that the Soviet Union has deployed now.

Could you elaborate what we are doing?

Dr. HICKS. My understanding regarding that issue is that we know that the Soviets have capabilities of intercepting warheads. The real problem is how many are they willing to let leak through?

In a nuclear war, leakage is a problem that must be faced and that can be devastating.

On the other hand, we also know the Soviets have enormous areas to defend, to keep their hierarchy of thousands of people. So if they did have a real nuclear exchange, knowing in advance when the exchange would happen, they could with some certainty, have major survival of their leadership in the country.

One wonders why they do that if they aren't thinking about that issue. Of course, it would only be good if they were the first strike type situation.

Going back to the point. I think that everyone involved with the small ICBM will concede that it should have penetration aids. In the discussions with the Defense Science Board, it is believed that 7,000 pounds over and above the 30,000 pounds would be needed to add enough penaids to do the job of decreasing the vulnerability of the reentry vehicle.

I think everybody feels comfortable that 7,000 pounds would do the job. It would, in fact, allow you to have enough penetration aids to make the leakage rate high enough to be unacceptable to the Soviets.

Mr. COURTER. In other words, without an additional congressional authority, one way or the other, if the Midgetman goes according to plan, when it is eventually complied, it will be 37,000 pounds?

Dr. HICKS. I think in the Air Force's mind they are already planning to have that acceptance. There has been enough discussion that they are waiting now to see what kind—I think the key factor will be the Defense Science Board repcrt containing its recommendations, and then a decision by members of this committee and a change to the Price amendment as to whether or not that 7,000 pounds can be added.

I would say technically almost without exception—Mr. Peters may differ—I believe that 37,000 pounds is necessary in order to have penetration aids.

Mr. BATTISTA. I wanted to comment, Mr. Courter, that I think you have to complete the whole picture, is what it amounts to, in going beyond the 33,000 pounds that the Congress has mandated.

For example, we have gotten, Mr. Courter, out of research and development sitting on the shelf, a mark of [deleted]. You don't hear discussions about making a single ICBM, giving it a MARV capability. That mark 500 would not be applicable to that.

The technology is there. You could also, within the 3,000 pounds, have penaids. The other thing you have to consider is do you want every component of the triad to have maximum effectiveness. There is the synergism there. You have the Trident II coming on line. The projected accuracy of that is much better than the Minuteman III. They are talking of kill capabilities, [deleted]. You have the Stealth, the SRAM II, the advance cruise missile, the remaining force of the MX, and the Minuteman. I think what you have to look at is a synergistic effect of all the components, and say what other options are there to MIRV it, like MARV'ing. I don't think you are at the end of the string yet on the capability you could put on the small single RV missile in terms of enhancing its penetration capability. That is all we are asking, that when you do this, take a look at the broad picture, the whole thing.

Dr. HICKS. That is right. I don't deny that is the thing to do. Except it is clear that we must do something. Most of the people I talk with, in fact everyone that I know who is involved in this matter, either contractually or in the administration, are thinking the 7,000 pound number.

I believe that we should be careful here if we do stay with the small ICBM with the single warhead, that we do not do something that a small increase would make a major difference in its effectiveness.

It does not make sense not to be realistic about 4,000 pounds. It will not change the concept at all, in effect.

So, that is where we are. In my discussions with Chairman Aspin, I found no problems with him in terms of that number, frankly. I suspect that when we get through all of these issues; the three warheads et cera, all of those issues about penetration will have to be brought into it.

That is true of the three nose cones and the synergism or the compatibility, as well.

Except we have always talked about having triads that exist by themselves for whatever reasons.

It is also turn of the number of hard targets that we have to contend with. Frankly they are much more than we have the ability to handle. We would like to have an effective warhead every time we send it in.

Mr. COURTER. What about the comment Tony made with regard to looking at MARV'ing?

Dr. HICKS. That is certainly a way of making it more difficult for the Soviets to hit the vehicle. The fact is I am not enough of an expert in marving to know whether or not the Soviets have that under control.

Mr. COURTER. Do we have the capability, the R&D capability?

Dr. HICKS. Yes, we do.

Mr. BATTISTA. We tested a Mark 500. We pulled G's with that. When you look at the engagement rules——

Mr. COURTER. Does it have an accuracy problem?

Dr. HICKS. It affects the accuracy.

Mr. BAYER. But you can use it to improve accuracy.

Dr. HICKS. We have to be careful with that. It may or may not.

Mr. BAYER. The P-II is a MARV-type system.

Dr. HICKS. It depends upon your accuracy in the first place. If you have lousy accuracy, you can improve it. If you have good accuracy like MX, you will not improve it with the MARV unless you build a much more complex terminal fix MARV. All of those things are for the experts to worry about, and have to look at all of them.

Mr. COURTER. I have one other area to cover. This probably does not really mean we have to be in executive session.

Since we are, we might as well stay. This is basically conceptually. It is something that bothers me. The theory behind Midgetman and as a matter of fact, a mobile missile, as you say one of the theories besides deterrence which people make the argument that the cost, the ratio favors the defense and makes it terribly costly for the offensive.

It takes a lot of RV's to kill one RV. Therefore, deterrence is increased if you have a one warhead missile. That is augmented, of course, if it is mobile. You are saying if the small missile, whether it be one or three RV's, if it is mobile the Soviet Union won't be able to see it, to determine where it is, and therefore whether you have a 70,000 pound, three warhead small missile or a 37,000 pound, one warhead small missile, the Soviet Union will have to expend as many RV's to kill it if you have the same basing area.

Then, of course, you have on the other side of that equation the research that is being done in strategic defense, whereby they are confident that they are learning the capability of tracking and discriminating tens of thousands of decoys, warheads, schrapnel, flying thousands of miles an hour. You are telling me that the Soviet Union won't know where a Midgetman mobile missile is going 45 miles an hour on the desert.

I find that very difficult to put together.

Mr. HICKS. You and I are obviously soul brothers, Mr. Courter. I have a problem with that issue myself. I have to say that excellent technical people looking at that issue have still come to the conclusion that it is an incredibly difficult task for the Soviets to be able to look at those vehicles, sort through the fact that one of the vehicles is really the vehicle, and not a clump of whatever, and finally be able to retarget their ICBM's.

Remember, these things are going to be going out speedily during the period that the ICBM's are flying in from the Soviet Union, so they have a [deleted] minute dash period to get to where they are going to go. Actually, in an alert, they would be pulled out part of the way, but they would be dashing further during that period.

I personally believe, at some point in time the Soviets will have that capability to engage individual targets from their bus. It is a very complicated, technical matter. I am not denying that. But it is certainly not more complicated than SDI.

The other thing is and I am not going to bring this issue up in executive session nor in the public session—but I do not want to take anything away from the issue of mobile-basing.

I do have some concerns about it. One of the reasons I lean toward deceptive-basing, is because that no matter what his accuracy is, what he has in terms of sensors, or what goes on, we would have, I believe, the ability to really prevent him from getting to the point where he knows how to do it.

There are too many aim points. Every time he adds missiles you add aim points without missiles. Theoretically, if you can do it it will cost him more than it does us.

There is also the difference between our two countries in that they have a mobile missile, and we have a very limited ability to do anything in time of war except, from the outside with our satellites, through the bombers, and so on. We cannot emplace sensors, and we do not have large numbers of sympathizers in the Soviet Union that might be equipped with communication through Satellite receivers.

I can give you a situation in West Germany where there are obviously enough problem people to concern us. What would happen during a period of war if people were to try to undermine the German capability?

I can see situations where large numbers of terribly diffcult to see sensors are in place. For example, in our country we could do it. People could play that game. The problem is that it is too easy in America to see things. We have highly sensitive bases where CBS News turns up outside trying to get in.

There is a softness to this basing situation that I think we are ignoring. It is a softness I cannot prove because of its incredibility and it does complicate it. It is hard to say rationally that they could expect to determine exactly where those things are. They don't have to determine exactly where they are, because they are only [deleted] PSI hard. They wouldn't have to make a determination that close to kill the vehicle.

If you accept the fact they cannot see the small vehicle, they will not be able to see the slightly larger vehicle either. It then becomes a matter of area. Let me point out something interesting.

Suppose you had one ICBM that was incredibly powerful. Suppose it had 1,000 warheads to come out of that 1 ICBM, and you based that over 20,000 square miles, you are either going to have 1,000 small ICBM's or whatever someplace in that area, or 1 ICBM

The Soviets have got to expend the same number of missiles, whether they are after 500 or 1, knowing the overpressure capability of their missiles and knowing what they have to do.

They have to saturate the entire area. They have to say to themselves, I have to put enough ICBM's in there to make certain that everywhere in that area, I have [deleted] PSI. If I don't, I might not kill a missile. If there is one missile there with [deleted] PSI hardness in that 20,000 square miles, he still has to blanket the whole area.

Mr. **Battista**. May I throw out a point for discussion? That is when we go back over the history of our country, we went from a nuclear monopoly, to strategic superiority, to strategic equivalence, to about in some areas nuclear inferiority right now. When you look at deterrence, it worked well when we had superiority. It since has transcended into a state of mind.

My thesis is as long as both sides can count holes, then both sides will maintain a level of deterrence that they feel is necessary to stop the other guy from going first.

Accordingly, and history proves me right on this, the arsenals have gone up, up, up. The beauty of the area dispersal system is that—and I have gone through the mathematics. I would be glad to give you my analysis.

You can see if it is flawed. I could be wrong.

With today's scenario, if you just colocated 300 small missiles with the MX and the remainder of the Minuteman III force, you generate about 44,000 square miles of land area. That says if you look at his accuracy right now, that it would require about 17,000 RV's on his part to take out 50 percent of your force. That says that there is no return on his investment in offensive capability.

That is what I was pointing out at the hearing in December and the one a few weeks ago. There is no administration policy that says where are we going in terms of arms control and not this administration, it goes all the way back to the Carter years and prior to that. Where are we going? What do we want to do?

Do we want to get away from the concept of fixed-based heavy ICBM's? Do we want him to do that too? Every time you have an [deleted]. I wonder why he doesn't have the same problem finding ours. The advantage of the 33,000-, 37,000-pound system is you can go off the roads, into the woods; you can generate more areas of deviltry, which makes his problem harder.

Mr. **Courter**. What you are saying, though—there is a difference of assumptions.

Mr. **Battista**. Yes.

Mr. **Courter**. The assumption of Dr. Hicks is you are using the same square miles for a 70,000-pound mobile missile as a 37,000 pound.

Mr. **Battista**. I am not sure we can do that.

Mr. **Courter**. If that is true, why not buy the argument that since the cost-exchange ratio is the same, save $20 billion?

Mr. **Battista**. If that is the case, it is worth looking at.

Mr. **Courter**. It is a very important question.

Mr. **Battista**. I would speculate a 275,000-pound system, gross weight, will be far more difficult to move through areas of deviltry off of highways.

Mr. **Courter**. The 275,000-pound system? Is that correct?

Dr. **Hicks**. There is still not enough detailed engineering. It is a good enough number. The numbers I use are about 250,000 and 170,000. I don't argue with that. We don't have the design to find that.

The thing I will argue with, I think the difficulty of moving the larger one around is overexaggerated. When you get to 170,000 pounds, you have a lot of weight. You have to do a lot of things to make things work right. But we have moved larger weights than 250,000 pounds. The last administration had a device moving MX, if you remember.

Mr. **Battista**. A lot of the cost was going to be beefing up roads, specialized roads, for the racetrack.

Dr. **Hicks**. That was 1 million pounds, by the way, Tony.

Mr. **Battista**. On the MPS. Again, that was specialized roads.

Mr. **Darden**. Since we are in executive session, I have a matter to bring up. I have been interested in this area since last year when we passed the Price amendment which, in effect, established a certain weight and a certain length. I was somewhat concerned about that. Quite frankly, out of high regard for the expertise of the chairman and the special staff member, I accepted that. I would like, if we could, while the Secretary is present Mr. Battista, go into actually the role of Congress and why Congress ought to be specifying a specific weight and a specific length and what got us to this portion that we felt compelled to do that.

Mr. **Battista**. From the congressional perspective, what got you to that position was a concern the arms race was getting out of hand. Both sides were acting unilaterally to increase the arsenals of their respective inventories.

There was a general perception that the way to get a handle on arms control then is to go to a lower value target. Technologically it is a step backward about 30 days.

The reasons we go away from small single RV missiles was two reasons. One, we MIRV'd them to get around the defensive systems. Two, the guidance costs were extremely high. So if you really want to do something economically, more efficiently, what you do is put as many objects on the bus as you can.

So, from an engineering perspective, this is a step backward. What changed in the equation is the capability of the Soviet Union now and the fact that both sides view deterrence in their own way. Consequently, we went to 3,000 to 6,000 to 8,000, to a projected number now I think on their side is 11,000 warheads.

When they will get to it is in the next few years. People up here began saying look, this is crazy. First of all, our conventional forces are suffering. We are putting too much money into strategic. I think the overall perception was how are you going to get a handle on the arms control race.

When I talked to Mr. Aspin about it a couple of years ago, I said look, as long as either side can count a hole, then that hole is the one that becomes targetable. As long as you can target that hole, it precipitates one of two things: the other guy digs more holes, but the SALT I treaty forbids that. What the Russians did is change the definition of a launcher. They have cold launch cannisters, and say that is not a launcher. They have a capability we don't have.

The fact of the matter is we are behind the power curve because they don't have OSHA, EPA, DSARC's. They just build, build, build. I think it was to our advantage to negotiate fixed-based heavy ICBM's and go to something that engineering wise is a step back, but in terms of arms control is more amenable to reductions. That is how we got there. The 33,000 pounds we negotiated with the Air Force, the Scowcroft Commission panel. By the way, that was not a congressional number. That was the President's Commission on Strategic Force Modernization that came up with that number.

Mr. HERTEL. That is what I am trying to get to. Where did that number come from.

Mr. BATTISTA. It came from the President's Commission.

Dr. HICKS. The President's bipartisan Commission.

One of the things I think we ought to dwell on here, though, is that we are getting in to the past again regarding where we are. The assumptions I made about maintaining modern technology in terms of MIRV'ing, and still having all of the things that the Commission was asked to do this for are still valid.

So if I go to the first level, if it turns out as I believe it will, that we can MIRV and go to 75,000 pounds and still have the [deleted] PSI hard mobile launcher, I think we ought to consider that heavily in terms of saving money.

Let's go back to the original arms control issue here. There are other ways you can do this but they won't be chosen.

Carry hard mobile which also does not violate the premise based on the fact that the Soviets and the United States wanted to make sure they could move capsules around. That is a way that would do it.

The question about carry hard is not a question of technology, it is a question of cost. Because there you can make 100 holes that look like the real missile or 1,000 holes that look like the missile. They are going to be hardened to [deleted] PSI, which means he has to to have certain accuracies; he has to target all of the holes. He can't just target the ones the ICBM's are in.

Another way of getting to the point where he doesn't know where he is, but of course, it doesn't satisfy Tony's arms control argument, is that he has to continue to build incredible numbers of offensive missiles. Very soon are constrained in small areas. Environmental protection is not an issue. You find yourself in a situation where, if you are doing it more cheaply than he, he says: Look, this is costing me too much money.

So my offensive desire is to continue, I call that a positive arms control. It does not depend upon some guy signing a piece of paper. It means he is playing a losing game.

There is no reason to continue to build those things the way he is doing it.

The other part of this matter that I think is important in terms of the arms control issue is that it depends upon the belief that we will never be able to see the missiles. We are working very hard to find ways to locate his movable targets. I would assume the Soviet technical establishment is doing the same.

Now, I don't know how successful it will be when it is time to do that. We are making progress. If it comes to a point that he can in fact locate the targets, you are back where you started. It is easier for him now than it ever was. He doesn't have to worry about accuracy. All he has to worry about is knocking you over with PSI.

If you go to carry hard or other deceptive modes—people assume I am an advocate of carry hard. I am an advocate of finding a survivable system, one of which may be carry hard. There are numbers I don't have yet that I need.

If you go to that deceptive mode, he can have zero CEP. He still has to expend one warhead for every hole in the ground.

Mr. BENNETT. May I inquire?

Mr. PRICE. Mr. Bennett.

Mr. BENNETT. Perhaps my questions will indicate that I really don't know all I should know about this. That is the reason I am asking the question.

Years ago, more than a decade ago, certainly, I was in correspondence with the Department of Defense about mobile nuclear weapons. I had envisioned as other people did using highway and rail tracks. Now, as I hear you talk, and I hear the conversation here, I have kind of a mixed feeling about what the President's status is, because I have a feeling you are talking about a certain number of square miles of having the offensive weapons placed and they are mobile already, but they are in a particular area.

Now, the Russians are not confronted with that. They have long railroad tracks, long highways. They expect to use their weapons up and down those highways, up and down the railroad tracks, and off base as well.

To me, that system was a pretty good system. Without knowing why I am wrong, I still think that is a good system. The size of the weapons does not impress me much except for other types of reasons. There are other reasons I can see for having a small mobile and single shot mobile which do not impress me as much as it does the mobility, the mobility and inability to be able to reasonably expect to knock these things out. That is much more attractive to me than small size or something else that may be involved in the Midgetman. In other words. I favor the Midgetman, but I favor it for reasons other than it being midget.

So I want an explanation from you why it is, since the Russians can do this, why we can't do it and don't want to do it, if we don't want to do it?

Dr. HICKS. Excellent question.

Mr. BENNETT. Thought it was.

Dr. HICKS. If you remember 24 years ago, we had mobile Minutemans and we were talking about that very same thing.

The issue is a complicated one. It depends a little bit upon the Soviets, and as you point out, our environments. I think we would have a terrible problem convincing the Governors of most States that they should be allowed to have Minuteman or any kind of a nuclear weapon going down the highway or on a railroad track.

Mr. BENNETT. I get elected every 2 years. I think that is an overstatement of an apprehension that is not well founded. You are not putting it in the right circumstance. You are saying that and I know you believe it. A lot of people believe it. I don't believe it.

I don't believe it because I think the American people know a nuclear war will wipe them out, no matter where they are. If we can get up a system that would let the opponents do what I have said we should be able to be doing, even though it might never be used, the fact it could be used, I think, would be accepted by Governors and people throughout the country as being preferable to the likelihood of going up in steam and vapor.

I really don't believe your are equipped to pass on it politically. I think I am better equipped to pass on it politically. I think I am better equipped to pass on it politically. I think you are wrong if you think that you cannot sell to the American people a system of using rails and highways vis-a-vis the other alternatives you suggested. I think you are 100 percent incorrect.

Dr. HICKS. I hope I am. I admire your position. I feel like that. I would vote that way any day of the year.

Mr. BENNETT. So would anybody else.

Dr. HICKS. I can remember a situation not too long ago when two Governors of two States out West killed a system called MPS.

Mr. BENNETT. That is entirely different. That is a coalized thing. They were asked to do something local in their State.

I am talking about something that could happen all over the United States, a policy that upon declaration of the President, we have that emergency available. You are talking about somebody who is trying to keep something out of their State. Like today—and it will mount. The question of all this nuclear manure that exists. Nobody wants it.

Eventually that will be a tough question to answer. But it will not be tough if everybody has to take their part of it. What I am talking about is where everybody takes his part. You are talking bout an historical thing where people objected, where their State was picked out to take the manure. That is a different situation.

Dr. HICKS. You had better be alert to small ICBM's. We are going to talk about five or six sites, mostly in the Western States.

Mr. BENNETT. That is the reason I don't like it. You ought to have a system where you can move it up and down any highway, any railroad. That is what you ought to do. I think it is a mistake to pick out five or six States.

You may be an authority on weapons, but I think I am an authority on politics. Up until 1 year ago, I had never been defeated for public office.

Dr. HICKS. I absolutely concede that point. I would be perfectly happy to support a weapons system like that.

I might add, I would want it to have multiple warheads.

Mr. BENNETT. I think you ought to think about it. I think you are perfecting and spending a lot of money on a system which I think is inferior. It would not necessarily be—I think it would be a less expensive system. I think it would be much more vulnerable in a vulnerable situation than you are planning to do. I think it is fraught with many less difficulties.

I think you are in a defense leadership of the country. I think you ought to have somebody thinking about it.

All you are saying in the Department of Defense is the politicians won't allow you to do it. I don't think you are the authority of what politicians would allow you to do. You ought to present the best system and see if we do it. If we vote for it, fine. You never suggested such a weapon to us. You should. That is what I am saying to you about that.

I don't want to take all the time, but I do have a very unhappy feeling about the movement toward more MX missiles when Congress has said they feel like they are very vulnerable weapons and want to go to other types of weapons.

I see this constant recurrence back to get more weapons. You asked for 21 more missiles.

Dr. HICKS. Those are test missiles, sir.

Mr. BENNETT. They could also be put in the holes.

Why would you need that many test missiles? Is the MX so imperfect you have to have 21 missiles to test it?

Dr. HICKS. You talk about the entire reliability of the system and what it has to do, we need 21 missiles to test.

Mr. BENNETT. Maybe I would have bought that if I hadn't read that Secretary Weinberger says he wants to go to 100.

Dr. HICKS. Let me separate the issue of the test missiles from the missiles deployed.

The other thing I want to say, and probably wasn't as clear as I should have been, the second 50 MX missiles we are talking about would have to be based in a survivable mode. That is a definite condition. The fact of the matter is the Air Force right now believes that super-hard silos, which will be 25 to 50 times harder than the MX silos, would meet that criteria.

I believe if the carry hard system could be built and if it is cost effective, it would meet that criterion.

I am not talking about more MX's without a basing mode which in fact is survivable. That is a condition imposed upon us by Congress for the next 50. I believe we have close at hand basing modes that can, in fact, take those next 50 MX's.

Mr. BENNETT. Going back to the hearings, the Secretary assured us downstairs we already knew how to harden them. We would do it right away. We never asked for them to be hardened. We got the testimony a year or so later after that saying we don't know how to harden it. So the credibility is very weak.

We realize Mr. Weinberger tells what he honestly thinks to be the truth when he says it, but he thought it to be the truth we shouldn't build them anyway if they were in the fixed silos. He said that. He testified to that about 5 or 6 years ago; 2 or 3 years ago he testified they ought to be in the silos I said they should not be in. And I said they couldn't be hardened. Sure, we can harden them. Then we said, why don't you set up something to harden them. He said, we don't know how to harden them.

With that kind of testimony, his great position of power as Secretary of Defense is very credible to the press and average people in my district and other people's district. When you read it, you realize it crumbles because he originally said, no way, put them in individual silos. Then he said, well, we will put them in the silos now. We can harden them. Then he said they couldn't be hardened. Now you are telling me they can.

It is incredible to me. I don't think Mr. Weinberger or you would tell an untruth, knowingly do it. But when you look back at the history of what has been testified to us, it is alarming.

Dr. Hicks. Mr. Bennett, I think that is a good point. It is part of what happens as technology proceeds. I would like to go back historically to what we have tried to do on basing MX. It is a confusing picture. Right now, for example, we are able to harden things to a level we did not assume we could do. We have found ways of hardening things to a much heavier amount.

Mr. Bennett. Maybe you weren't sitting in this room. It was this very room. When they talked to me, they didn't talk to me—I guess they thought I was on the team. They didn't talk like they thought they would find something to do. They talked as if they had fulfilled the President's requirement for a package. Not a package that was good, but one they could politically sell.

I was very offended by that. They were not talking to me and using words and thoughts that indicated that they really thought they had a good weapons system at all. They were talking that the President has asked us to come up with something that could pass Congress, not something that was good that could pass Congress, but something we could say we are going to build the MX's.

That is the hearing that turned me off when I heard all of these people, all of whom I admire as individuals, and I was doing as I am talking to you now. I said, you are not talking about whether it is good or not; you are talking about whether you can pass it through Congress.

Mr. Scowcroft said, that is what we were told to do, come back with something that could pass Congress. I don't think we ought to do that in procuring weapons.

Dr. Hicks. I guess I believe my job is to be honest, and to technically bring out the issues and let the politics be given to somebody else to worry about.

I would like to meet with you and spend more time alone going through the history of that. I will also make sure that I bring myself up to speed.

There are nuances I have forgotten. But to tell you where we are now, and why we are where we are now, it is my belief that it is only an issue of costs. We can find basing modes for MX's that are invulnerable.

The other thing I want to say about the small ICBM, we have direction by Congress that it shall not be deployed except on DOD and DOE lands. That is part of the language. So we are constrained by Congress.

Mr. Bennett. You are talking to Congress. Egads, that is like people back home. I didn't expect to hear this from you. Back home people say we can't change that, that is the law. It is not in the Constitution. If you come up with a system that is better, makes more sense for the defense of our country, costs less money, is more secure, it is your responsibility to come up with it, not to say the law says you can't do it.

Dr. Hicks. That is why I came up with three-warhead missiles for the mobile missile.

Mr. Bennett. That may be a good point.

I am a very simplistic person I am saying what I am thinking. I have never voiced these thoughts publicly. I never voiced them publicly. I don't want to embarrass anybody.

I think we look like a bunch of fools as a result of the Scowcroft Commission. I think that was a very, very awkward thing for people to look at politically. They basically made a political decision about a weapon. That is a poor way to choose weapons.

Dr. **Hicks.** I concur.

Mr. **Bennett.** I have said everything I want to say. I am not a brilliant individual. I am not a master of these kinds of weapons. For that reason alone, I don't make public a lot of my comments and thoughts about the matter. They are nonetheless very sincere. I am very sincere in feeling we should not be looking at a weapons system that is mobile that has to be restricted to a small piece of geography. I think that is a loser.

I think we ought to get to something that makes more sense, which is, we could use all highways, all rails, everything else if we want to do it. I think it takes leadership. If the President can lead us to the 1981 tax cut, Gramm-Rudman, he can lead us to something like this that makes so much manifest sense.

Dr. **Hicks.** Sir, I will certainly come over and spend time with you personally on this subject.

Mr. **Battista.** Mr. Secretary, one point you might want to consider. You were talking about deception. There is certainly a lot of advantage to deception.

You might want to consider, in terms of quid pro quo and to allay the concerns about the growing arsenals, maybe you want to deceptively deactivate the Minuteman II force. That perhaps could lead to the Soviet deactivation of their SS-11 force, deceptively.

You can take the warheads out, the missiles out. You keep the aim points the same. Certainly that might be the quid pro quo for getting more support for strategic modernization.

Second, could you go back and review the recent firing of Dr. Burrell Hays out at China Lake?

Dr. **Hicks.** I don't know anything about it.

Mr. **Battista.** He is the Technical Director there. He has responded to a lot of congressional initiatives, the Skipper, the low-cost Seeker which everybody heard about on ABC as to how the Secretary of the Navy cut through the bureaucracy.

Yet, in spite of all his accomplishments, he was told this past week, you have 15 days to either resign or come to Washington in an obscure job as Director of Navy Labs, which is tantamount to firing.

I would like to give you something that you might want to review. That is the history of the HARM Missile Program. There is a lot going on here; for example, the Navy's current plan to do a HARM IV now and in addition to that, to funnel the low-cost Seeker money to the same contractor.

Now, what they have done to get more firmly entrenched in HARM with that contractor is to require the other two guys, the competitors, to facilitize at their own expense. That is tantamount to locking yourself into putting all the arms for the United States into one location in the world.

I would be glad to give you the history on that.

Dr. **Hicks.** I would be glad to look at it. I know nothing about the situation at all. It is news to me.

Mr. **Price**. Mr. Secretary, I think we can excuse you for the rest of the day.

We will resume the meeting at 2 o'clock with Mr. John Krings, Director of Operational Test and Evaluation.

Dr. **Hicks**. Thank you, Mr. Chairman.

[Whereupon, at 11:45 a.m, the subcommittee recessed, to reconvene at 2 p.m., this same day.]

## AFTERNOON SESSION

Mr. **Price**. The subcommittee will be in order.

Our next witness will be the Honorable John E. Krings, Director of Operational Test and Evaluation. The Office of the Director of Operational Test and Evaluation was created by Congress in Public Law 98-94 as part of the fiscal year 1984 DOD Authorization Act.

According to Public Law 98-94, the Director is to report both to the Secretary of Defense and to the Committee on Armed Services the results of operational test and evaluation.

Following Mr. Krings' testimony, we will take testimony from Dr. Robert C. Duncan, Director of Defense Advanced Research Projects Agency [DARPA]. This will be followed by Lt. Gen. John L. Pickitt, Director, Defense Nuclear Agency.

Due to the compressed schedule, we will not be able to take testimony from Ronald T. Thomas, Director, Program Control and Administration.

Mr. Thomas' statement will be fully entered into the record.

[The statement of Mr. Thomas follows:]

## Prepared Statement of Ronald T. Thomas, Director, Program Control and Administration

Mr. Chairman and Members of the Committee:

Research and analysis for the Office of the Secretary of Defense (OSD) and the Organization of the Joint Chiefs of Staff (OJCS) play an important role in almost every facet of the DoD's central planning and decision process. It provides information to the Department's decisionmakers at all levels, and represents an investment of new ideas and pays off in future improvements to the Defense establishment.

The Congress has questioned the DoD research and analyses, or studies program, in terms of the effectiveness or utility of this effort, the Department's management policies and practices, and the extent to which it employs outside contractors. Over the past several years, the DoD has taken steps, described later in this statement, to respond positively to these concerns.

The FY 1987 Defense Budget request for OSD/OJCS outside research and analysis supports a sound program designed to satisfy our needs through prudent utilization of the quality effort available from outside contractor research. This statement describes the Budget request for outside research; the purpose, role and uses of research and analysis; and how and why the contributions of outside research organizations are essential; and how the Department manages this effort.

### I. Budget Summary Request

The Office of the Secretary of Defense and the Organization of the Joint Chiefs of Staff request $66.281 million in FY 1987 for research and analysis. This request reflects the organizational changes in OSD in the last year including the creation of two new Assistant Secretaries. These funds will be allocated as follows:

| | Dollars (Million) |
|---|---|
| | Total |
| Under Secretary of Defense (Research and Engineering) (Technical Support PE65104D) | $15.463 |
| Deputy Under Secretary for International Programs and Technology (PE65110D) | 3.474 |
| Organization of the Joint Chiefs of Staff (Also from PE65104D) | 5.154 |
| Director, Program Analysis & Evaluation (PE65106D) | 3.912 |
| Under Secretary of Defense (Policy) (PE65107D) | 6.931 |
| Deputy Under Secretary for Trade Security Policy (PE01015D) | 1.739 |
| Director, Net Assessment (PE65108D) | 4.415 |
| Assistant Secretary of Defense (Force Management and Personnel) (PE65109D) | 2.049 |
| Rand Research Center Support for OSD/OJCS and Defense Agencies (PE65112D) | 16.717 |
| Assistant Secretary of Defense (Command Control, Communication & Intelligence) (PE65116D) | 3.164 |
| Assistant Secretary of Defense (Acquisition and Logistics) (PE65119D) | 3.263 |
| Total for all Program Elements | $66.281 |

## II. INTRODUCTION

### A. The Role of Research and Analysis

The basic management functions of the DoD are to develop defense policies and strategies to support U.S. national security objectives; to plan, program and budget the resources needed and currently available to achieve defense objectives; to plan the doctrine, level, acquisition, composition, training, deployment, maintenance, and employment of U.S. military forces; and to direct military operations. The planning and decision processes in each of these areas are both dynamic and continuous. Defense planners and decisionmakers must carefully consider both the near and far term implications of available decision alternatives, assess a large number of complex and often rapidly changing factors, and cope with generally high levels of ambiguity and uncertainty.

The significant increased near-term need in the readiness of our deployed forces makes it imperative that we examine existing and alternative policies, planning, operations, programs, and budgeting; i.e., are they realizable, effective and efficient, and do they meet firm requirements? Specifically, through the use of outside research the merits of alternative mixes of scout and attack helicopters in antiarmor teams was examined. The study helped OSD place the scout helicopter issue in clearer focus, and thus influenced the DoD position on Army scout helicopter programs.

Another example of outside research used to support near-term needs is the development of analytical models for the OJCS for estimating cost and effectiveness of alternative force mixes for the FYDP years. Work is continuing on an integrated model and data base which would contain expanded cost and effectiveness modules, and extend the analytical time horizon to the end of the century. This methodology will give JCS the capability to analyze in aggregate terms the cost and effectiveness of all major force components: general purpose, strategic nuclear, and mobility. It will have the flexibility to assist in the evaluation of alternative force postures against a broad range of scenarios, threats and warfighting strategies.

The OSD/OJCS research and analyses contributes greatly to the validation of such assessments and evaluations. The program enables us to achieve needed balance and perspective on technology and strategy through a combination of outside experience and expertise. In conjunction with in-house civilian and military knowledge of mission requirements, deficiencies, and threats, outside research and analysis is used by OSD/OJCS to address the complex and dynamic problems confronting us today.

In addition to their specific relevance to the near-term decision process, these analyses and assessments provide a framework to support the decisionmaker's understanding of the multi-faceted environment in the long-term context in which major defense problems and proposed solutions must also be considered. Intelligent decisionmaking and resource allocation also requires a disciplined assessment of threat, requirement trends and progress in the technical-military areas of research, development, acquisition and logistical support.

There is, in fact, almost no area of the defense policy making, planning, programming and budgeting process that is not affected by the inputs from research and analyses. The ultimate value of outside research and analyses lies in how well they assist the decisionmaker in the near and far term in narrowing the focus of his judgments to those areas in which judgment alone must be applied.

## B. The Need For Outside Research

A major and continuing thrust of our defense research and development program is to achieve better utilization of the competence in our civil technology sector. Our approach to the outside research and analysis program is consistent with this thrust. We seek out the best ideas, methods, and unique competencies in the nation which highly diversified external research organizations can collectively provide. Both the environment within outside research organizations and the competition among them provide incentives for developing new ideas and innovative perspectives for DoD management needs.

Illustrative of the impact that outside research and analyses can have on OSD/OJCS activities are the following:

- Increase or improvement in effectiveness, efficiency, productivity and savings in the use of resources: Work on alternative upper stages to boost military satellites into geosynchronous orbit from the space shuttle formed the basis of a DoD Inspector General report recommending reassessment of current plans. The recommended alternative may offer around $30 million in savings per launch.

- Validation of military requirements, strategy, tactics and doctrine: Outside research helped DoD by providing technical inputs and analyses to develop an Antiarmor Master Plan requested by the Congress.

- Providing a rationale and priority for allocation of resources: Two examples are: (1) in response to JCS tasking, outside research produced a first-stage set of analytical models aimed at quick and comprehensive assessment of the capabilities, costs and risks of alternative military force mixes; (2) a methodology was developed for predicting Navy operating and support costs in the aggregate as a function of observed physical characteristics (numbers and types of ships, aircraft, etc.). This methodology is used by OSD in the program and budget review process to evaluate type of reasonableness of Service O&M submissions.

- Acquisition of new ideas and knowledge: Work on infrared, electro-optics, tribology, remote sensing, cloud and dust phenomenology and other areas has been used by defense agencies to assist in technical management of programs and provides technical expertise and a corporate memory available for use in many DoD activities.

- Identification of longer term issues and problems in national security policies and programs: Examples are: (1) an innovative conceptual design for a sensor which will allow early corroboration of ICBM launches, reduce dependence on space-based sensors, and could help improve the stability of the US/Soviet strategic nuclear relationship; and (2) at the request of OJCS, a projection of alternative strategic environments was developed for the years 1994-2004 - these have been extensively used in the preparation of the Joint Long Range Strategic Appraisal.

- Analysis of options and alternatives to support policy, program, budget and acquisition decisions: Three examples in this area are: (1) continuing research on the cost-effectiveness of defense training technology has helped OSD provide guidance to Service programs, and has assisted OSD to respond to the Congress concerning guidelines for development and acquisition of training devices and simulators; (2) work on NATO Counterair issues assisted OSD in the development of programs and budgets with respect to anti-tactical missile, air defense and airbase attack systems; and (3) external support of the DoD in COCOM negotiations helped in the achievement of multilateral controls on about 75 new critical products and technologies, including computer hardware and software.

Outside research and analysis support, when needed, is provided by contractors, universities, small and minority firms, not-for-profits, and federally funded research and development centers (FFRDCs) to enable OSD/OJCS to take advantage of special pools of talent and experience such as: special areas of expertise which are neither available nor necessary on a full-time basis within the Government; industrial and academic leaders; and experienced professionals no longer available for Government service. Analyses performed by qualified contractors aid in discriminating among competing bureaucratic interests so that a reasonable degree of objectivity can be brought to bear on certain issues and problems. Management of the research and analyses program or technical/analytical support is by high-level DoD authorities who plan, initiate, approve, monitor, review and evaluate products to ensure the results will be beneficial and made available for widespread distribution to satisfy the needs of others.

## C. Managing OSD/OJCS Outside Technical/Analytical Support

I am pleased to report that OSD has completed a thorough overall review and management improvement of its technical/analytical support processes and procedures. This effort is entirely consistent with the new DoD Directive on contracted advisory and assistance services (CAAS) signed in January 1986. Indeed the OSD management effort was the prototype and test bed for the DoD Directive.

The Directive provides sound and consistent definitions for CAAS and its four components (Individual Experts and Consultants; Studies, Analyses, and Evaluations; Management Support Services; and Engineering and Technical Services) and incorporates a comprehensive summary of the policies and procedures, both old and new, for managing CAAS.

- The Chief Management Requirements of the Directive include: (a) annual plans justifying CAAS requirements; (b) annual reports summarizing results; (c) individual evaluations of the services provided and contractors' performance; (d) use of DoD Components' accounting systems to record CAAS obligations; (e) an annual budget exhibit reconcilable with the annual plans; (f) supporting data to permit comparison of planned and actual obligations; (g) identifying and accounting for all CAAS, whether in a separate contract or as part of a non-CAAS contract; and (h) establishment of DoD Component CAAS Directors at the flag or SES level with the authority to approve or disapprove CAAS requests and to be responsible for all CAAS activities in their respective Components.

The management improvements now in effect in OSD provide a coherent, documented process for planning, managing and evaluating contract research; and include:

- Designating the responsibilities of the OSD Study Coordinator (who is in accordance with the new DoD Directive now called the OSD Component CAAS Director) to provide general policy guidance and serve as the focal point for our contracted technical/analytical research efforts. Specifically, he is responsible for coordinating and monitoring the programming and management of contract research and analyses; identifying potential duplication and candidates for joint funding, and those not relevant to the sponsoring organization's mission or area of responsibility. He also provides procedural guidance to ensure efficient management, standardized documentation and evaluations of completed research.

- Providing an annual process to monitor research requests from the beginning of the budget planning process through actual contracting. OSD components send their proposed research plans to the OSD Study Coordinator for review; he assembles each component's plan into a single document which is circulated, for comment and review, throughout OSD, OJCS, the Services and the Intelligence Community to identify potential duplication and candidates for joint funding. Comments received are used to prepare the final plan which is approved by a high level DoD official before the start of the new fiscal year.

- Ensuring that the planning process is adhered to by each OSD/OJCS component by comparing all requests for technical/analytical support contracts to the approved study plan. If a proposed research request is not in the approved plan and needs to be accomplished in the current fiscal year, the component submitting the request must provide justification explaining why the requirement was not identified in the approved plan. This ensures the planning process is made to work.

- Reporting proposed and completed studies to the Defense Technical Information Center and requiring the preparation of an evaluation of each project completed during the fiscal year. This evaluation explains how the results of each project were used, its impact, and how the contractor performed.

These efforts, most of which have been computerized, represent better management, control and utilization of our limited technical/analytical support money. For the first time, there is a single point of contact (OSD Component CAAS Director) who has a complete and automated picture of OSD/OJCS technical analytic support efforts and requirements.

## D. Conclusion

Our FY 1987 budget request for research and analyses support is a high leverage investment to support decisionmaking throughout the OSD/OJCS. Results from our research are utilized to address the myriad of complex issues and dynamic problems facing the Department. It provides us the capability to examine and assess the implications and consequences of current and alternative policies, plans, operations, strategies and budgets. Through such research, we gain insight into the complex technological, military, political, and acquisition environment in which future defense decisions and problems will be posed, considered, and made.

We are convinced that the support we receive from these sources is essential in our efforts to improve DoD's responsibility to the American public to enhance our national security, at affordable cost, in a rapidly changing and complex world. We urge the full support of the Congress for the $66.281 million requested.

## III. INDIVIDUAL OSD/OJCS BUDGET JUSTIFICATIONS

### A. OFFICE OF THE UNDER SECRETARY OF DEFENSE (RESEARCH AND ENGINEERING) PROGRAM ELEMENT (PE) 65104D; CRITICAL TECHNOLOGIES PE 65110D; AND RAND RESEARCH CENTER SUPPORT FOR OSD, OJCS AND DEFENSE AGENCIES PE 65112D.

#### 1. OFFICE OF THE UNDER SECRETARY OF DEFENSE (RESEARCH AND ENGINEERING (OUSD(R&E)), PE 65104D

The $15.463 million requested in FY 1987 supports outside research and analysis under the cognizance of the OUSD(R&E).

A key objective of the OUSD(R&E) outside research program is to provide analyses, independent assessments, and innovative ideas to assist planners and decisionmakers in their efforts to apply R&D towards improving the efficiency and effectiveness of the Armed Forces. These funds are used to support the OUSD(R&E) in the exercise of his responsibilities including: (1) overall responsibility for the defense R&E program; (2) development of an integrated long range strategy for the allocation and use of research and development resources; (3) maintaining our technological superiority and translating our technologies into deployed military equipment; (4) exploiting more fully our industrial base and our existing DoD R&D capabilities, the technological and industrial strengths of our allies; and (5) improving our understanding of the US/USSR technology balance and the impact of Soviet R&D on our defense posture; (6) enhancing our ability to look at resources allocation in a cross-service, mission area context; (7) meeting our export control responsibilities for arms and defense-related technologies; and (8) improving the inherent deployment, endurance and sustainability of our weapons through technology and improved augmentation approaches.

While it is usually not possible to determine the full value, impact or benefit derived from recently completed research and analyses, the results when evaluated and assimilated will lead to new insights and better informed decisions. The following are examples of contributions of outside research and analyses efforts conducted in the last few years.

- As a result of a recently completed research, DoD prepared an entirely new Antiarmor Munitions Master Plan (AAMMP).

- Research and analyses on computer aided logistics support provided the basis for a broad expression of DoD policy in a letter from the Deputy Secretary of Defense to the military departments and Defense agencies.

- Analysis of data base requirements for Joint Tactical Command and Control led to a security configuration that entailed substantial cost savings.

- Externally conducted research led to the development and promulgation of the unclassified Militarily Critical Technologies List (MCTL). The unclassified version allows wide access, for the first time, to industry, academia and the public to specific information on the technology security program. The classified MCTL and foreign capabilities have directly assisted U.S. government personnel in making export licensing decisions, in COCOM negotiations, and in complying with the Export Administration Act.

- Research into the area of sensor and signal processing produced the first DoD-wide look at these diverse programs and is developing a set of issues regarding their management. Analysis of this research will identify alternative investment options to meet specific long-term requirements and a conceptual framework to examine, coordinate, and direct the DoD-wide technology base program in signal processing.

- Research and analyses of the impact of new technology on future weapon system support requirements will identify areas of high payoff. This effort is a key element of the critically important effort to improve weapon system support and combat sustainability. The analyses to date has identified the major difference in the requirement associated with peacetime versus combat operations.

The FY 1987 OUSD(R&E) program of outside research represents a selection of presently identified requirements. The thrust of the research is to supplement or complement in-house knowledge on a wide range of key issues under the cognizance of the OUSD(R&E). These efforts are not duplicative of each other, but are designed and managed to provide payoffs that provide a synergism in efforts and capability.

The common theme of these efforts is the comprehensive analysis of force and force management capabilities and deficiencies for mission accomplishment; the focusing of technology efforts to meet longer range mission needs. A central issue is, a determination of capabilities and limitations of a force to accomplish its assigned mission: i.e., weapon systems, target acquisition means, command, control and communications or other supporting capabilities. Such analyses must additionally take into account concepts of operation, combat doctrine and tactics and the possibility of threats evolving in reaction to our existing and near-future capabilities. Other important areas include work in emerging technology initiatives, arms cooperation, long range planning, and improving weapons costs estimates.

Planned research and analyses for initiation or continuation in FY 1987 include:

- Bomber Force Modernization: The U.S. is now in the midst of the most significant modernization of its strategic bomber force since World War II. Production programs for the B-1B, Advanced Technology Bomber (ATB), ALCM (AGM-86B), Advanced Cruise Missile (ACM) and the SRAM II are underway or planned for the near future. The most dynamic problem facing these forces is survivability. The Soviets continue to develop and deploy new air defense systems (e.g., SA-10, SA-X-12, etc.), usually with newer and more sophisticated capabilities. Our knowledge of these capabilities, and the assessment of the key weaknesses of these defenses, is a critical factor in force planning. In addition, the emergence of strategic relocatable targets (SRTs) as a critical new target class has forced a complete reexamination of bomber targeting concepts. This continuing study effort provides the unique ability to evaluate the impact of new threats on current and planned systems, develop cost-effective alternatives and tradeoffs, and eventually help direct the acquisition strategies for strategic bomber forces.

- CONUS Air Defense (Low Observables): The value of low observable technology for the penetration of air defenses was a key factor in the development of the first generation cruise missile--the ALCM. We are continuing that technology initiative. There is a growing concern with the possibility of Soviet use of low observable technology and modern ECM techniques in their new cruise missiles, particularly the SLCM. Soviet submarines launching SLCMs from positions offshore could provide a surprise "leading edge" cruise missile attack against our bomber forces. This is probably the most significant problem facing U.S. defensive forces, and we must be able to develop potential U.S. strategic air defense responses.

- Antiarmor Munitions Master Plan: This effort is a continuation of FY 1986 activities to update an antiarmor munitions master plan. Tasks associated with this research include: analyze service requirements methodologies for adequacy and individual issues regarding antiarmor munitions e.g., lethality, countermeasures, mix; perform abbreviated analyses to assess adequacy of involving projections; assess the feasibility of various programs based on schedule and technical approach; identify potential redundancies/duplication; and, other related tasks.

- Development of Integrated Systems for DoD Conventional Munitions Planning and Management: Each of the Services has its own approach to munitions planning. Each Service has unique requirements methodologies, effectiveness models, and decisionmaking criteria and variables used during the PPBS process culminating in POM submission. The variety of issues generated during this process must be analyzed from an OSD perspective. Currently, OSD does not have the integrated, cohesive planning and management process necessary to properly evaluate many of the most critical munitions issues. This effort will provide for a comprehensive DoD Conventional Munitions Master Planning and Management System which provides the framework and operational guidelines for OSD-level conventional munitions requirements analysis and budgetary planning. The planning system will include development of an OSD munition requirements methodology and automated munitions data system; and preparation of a Conventional Munitions Master Plan.

- Targeting Tactical Ballistic Missiles: Enemy Tactical Ballistic Missiles (TBM) have become an important emerging threat to the US and NATO forces. Methods to target and attack these threats need to be established and demonstration testing performed. A system to defeat this threat is required.

- Inter- and Intratheater Mobility Forces: Previous and current studies have dealt separately with intertheater mobility requirements, capabilities, shortfalls and potential improvements. Corrective actions have been initiated as a result of these studies. However, little effort has yet been given to the problems of the interface between them (e.g., sea to land, intertheater air to intratheater air). The introduction of the C-17A in the early 90's will make available an aircraft that will be capable of both intertheater and intratheater airlift, which lends a degree of reality and urgency to the problem. The study results will be used by the OSD staff in preparing Defense Guidance for FY 88-92.

- Impact of New Technology on Future Weapons Systems Support Requirements: This effort is needed to identify those areas in which technology can be used to reduce weapons support requirements and improve readiness for combat. Technology has been developed primarily to improve performance of weapon systems or to reduce weight and volume. The increase of support requirements which have resulted from these sophisticated weapons have imposed a severe burden on the logistics support system. The goal of this effort is to use technology to reduce that burden.

- Cost-effectiveness of Human Factors and Training Technology: Over the past few years, cost-effective methods and data requirements have been developed under the sponsorship of this office and delivered to the Services. They have been utilized for specific situations (flight trainers, computer assisted instructional systems) by the Services, industry, and many foreign countries. It is now necessary to integrate these methods with recently acquired data from NATO and the Services and develop it as a series of nomographs, retention curves, and design trade-offs.

- Investing R&D Resources in Emerging Technologies: It has been the policy of the U.S. to rely on advanced technology to maintain as large a qualitative edge as possible to balance Soviet numerical superiority. Work in emerging technologies will provide us with a clear focus on (1) the areas where the U.S. should invest R&D resources, and (2) an understanding of what technologies should be denied to the Soviets through COCOM and other controls.

- Nuclear Weapon Cost/Benefit Studies: Competing requirements for nuclear weapons, including both new systems and modernization of current systems, exceed our ability to satisfy needs completely. Limitations exist both in money available and in special nuclear materials (SNM). These resource constraints will become more severe in the next few years. Thorough justification of nuclear weapon requirements was a major topic of review during the recent DoE/DoD Blue Ribbon Panel study.

- Proliferating Nuclear Forces/Impact on DoD: Nuclear proliferant nations are now reaching the point of assembling, or may indeed have already assembled, stockpiles of nuclear weapons. The threats that these developments bring to national, regional, and international security have been apparent for years, but little hard analysis has been devoted to evaluating the specific risks that are posed for US interests. The risks to US interests are particularly acute in countries where internal political instability creates the risk that custodianship of small nuclear forces might fall into irresponsible hands, either inside or outside the current government. In this event, the consequences for US defense interests could be staggering.

- NATO Warsaw Pact Acquisition Balance: Effort will provide an overview of the US/USSR technology and acquisition balance including quantitative and qualitative findings supported by defense and intelligence agency assessments. Consideration will be given to the following substantive areas: production and procurement rates; force levels; measures of force modernization; resources committed to military RDT&E and procurement; development and maintenance of an appropriate data base; goals and characteristics of the military acquisition systems of the U.S. and USSR; technology comparisons and important trends in these areas.

- Refinement and Utilization of the Defense Resource Model: In order to support decisionmaking with regard to mid-term resource tradeoffs/priceouts of marginal force/procurement changes and long-term Extended Planning Annex forecasting based on ongoing FYDPs, utilization of the Defense Resources Model is required. The Defense Resource Model must be further refined to: provide rapid capability for assessment of budget and force alternatives; quantify statistical correlation within the FYDP; account for support costs by DG Mission Areas and appropriation; and, be more flexible and available as soon as possible after the input of each new FYDP during the PPBS process.

## 2. OFFICE OF THE UNDER SECRETARY OF DEFENSE (RESEARCH AND ENGINEERING); CRITICAL TECHNOLOGY CONTROL PE 65110D

The $3.474 million requested in FY 1987 supports outside research and analysis requested for support critical technology control. In the Export Administration Act of 1979, Congress mandated the development and maintenance of a list of militarily critical technologies. This list is developed and updated each year in conjunction with technical experts from industry and the DoD components. The effort for export control involves the activities required to develop technical proposals for items to be controlled because of national security reasons and to defend these proposals in the international arena. It includes the implementation of U.S. export controls and the methodology of reviewing significant requests for export licenses.

The FY 1987 program will update the development of the overall list of emerging technologies and supporting documentation. The study program will consist of studies and analyses supporting the essential decisionmaking process in critical technologies for OUSD(R&E): including development of the Military Critical Technologies List (MCTL), guidelines for appropriate use of the MCTL, development of supporting documentation for the MCTL, negotiations with Coordinating

Committee (COCOM) nations on embargo lists, NATO technology transfer reviews, and other studies related to identification and definition of critical technologies for use in all appropriate technology transfer decision processes. In 1987 there will be continuing effort to develop suitable rationale for: export control of critical items; to decontrol non-critical items; and, to improve the technology transfer decision process.

### 3. RAND RESEARCH CENTER SUPPORT FOR OSD, OJCS, AND DEFENSE AGENCIES PE 65112D

The $16.717 million requested for the Rand Research Center, a Federally Funded Research and Development Center (FFRDC), is to provide research support to OSD, OJCS and Defense Agency user organizations' planning, policy formulation and decision making processes.

The Defense Advisory Group (DAG), a top level group composed of principal users of the OSD FFRDC at Rand, chaired by the Under Secretary of Defense for Research and Engineering, has been established to provide policy guidance, allocate resources and establish plans to provide the optimum performance of the Rand effort for OSD, OJCS and Defense Agencies. Each participating OSD element or agency will control the research to be done for that office. The broad objectives of the program are to: (1) ensure access by all OSD components to independent interdisciplinary expert research capabilities covering a broad range of relevant specialities; (2) institutionalize capabilities for analysis of major research objectives that cut across the responsibilities of individual OSD components; and, (3) ensure that OSD will continue to have available the benefit of these long-term programs and capabilities in the most productive and useful way.

Rand research for the DoD includes work on strategic communications, survivability of space-based surveillance systems, meeting DoD quality and quantity enlistment requirements, arms control, strategic defense, international terrorism, Soviet weapons technology, and military economies of Communist bloc countries.

The FY 1987 program in those areas authorized by the Defense Advisory Group will evolve from Rand's prior year efforts for OSD, OJCS and Defense Agencies and will be closely aligned with issues of critical importance to the DoD. The research will be conducted through a program designed to provide an intellectual focus on broad areas of inquiry, identification and effective exploitation of new methodologies to enhance the DoD's policy making capabilities and new technologies to enhance future defense capabilities.

## B. ORGANIZATION OF THE JOINT CHIEFS OF STAFF, PE 65104D

The organization of the Joint Chiefs of Staff is requesting $5.154 million for external research and analysis to support the decisionmaking process within the Joint Staff.

The statutory functions for the OJCS require them to prepare plans, policies and doctrine and to provide for the direction of operations by the unified and specified commands when directed by the Secretary of Defense. Their specific responsibilities include: (1) serving as the principal military advisers to the President, the NSC, and the Secretary of Defense; (2) serving as military staff in the chain of operational command to the unified and specified commands; (3) providing strategic direction of the Armed Forces; (4) reviewing plans, programs, and requirements; (5) providing US military representation to international security organizations, mutual defense boards, and commissions; and (6) providing statements of military requirements and strategic guidance for use in the development of budgets, military aid programs, industrial mobilization plans, and research and development programs.

Recently, the responsibilities of the Joint Staff have grown dramatically adding new agencies and functions; such as the Strategic Plans and Resources Analysis Agency, The Joint Special Operations Agency, and The Joint Operations Planning and Execution System (JOPES). The integration of these new missions and functions into the joint arena requires a broad expertise which is still being developed within the manpower resources of the Joint Staff.

Increasing the real warfighting capability of joint forces, improving the effectiveness of interservice tactical and strategic communications, increasing the effectiveness of weapons, communications, tactics, and doctrine for operations with our allies, integrating the new dimensions of space based weapons and sensors with land, air, and sea forces, and moving the Service programs toward better support of operations of worldwide, multi-theater, joint forces are some of the primary areas in which the Joint Staff needs to call on highly qualified experts to assist with the investigation of alternatives through contract studies and analyses.

Support to increase the warfighting effectiveness of joint forces will concentrate on providing the military planners with computer based analytic tools to assess the movement, supply, and attrition of joint forces in alternative theater and region campaigns. Additionally, studies will provide recommendations for improving the logistics support to our deployed forces, improving the availability and preparedness of the active and reserve forces to mobilize, and improving the nation's industrial base for wartime surge even under anticipated budget constraints.

The Congress has asked the OJCS for an independent assessment of the capabilities, cost, risks, and other factors rising from the Service programs. Preparation for these assessments is well underway. Contract assistance will be needed to develop methods to rapidly assemble and sort the large Service data bases of programmed forces, supplies, and costs and to develop the computer based tools to compare and assess the impact of these separate programs on the warfighting ability of the resulting combined forces operating worldwide. Other studies provide for the assessment of accuracy and reliability resulting from the operational test and evaluation of strategic missiles, joint functional requirements for line of sight tactical command and control, development of a joint data base system and methods for joint logistics and strategic mobility, modeling of Strategic Defense Initiative (SDI) systems to assess the effect of these advanced technology systems on the numbers, capabilities, and deployment of our future strategic and conventional forces. Additionally the OJCS requires the development of net assessment methods and critical data elements for strategic and theater threat analysis and the formulation of recommendations to improve the U.S. industrial base to support total military mobilization.

Beyond providing high quality technical assistance to the senior Defense decision processes addressing these contract areas, the OJCS study program produces high return on the investment. Recent examples of high payoff studies include: greatly improved evaluation and critique of joint exercises so that better methods, tactics, and doctrine can be gleaned from this experience; improved response to the arms negotiations processes by reducing the turn around time for analysis of trade-offs from days to hours; a new analytic tool for the CINCs to quickly formulate and assess war plans and joint courses of action against contingencies and "what if" situations; a demonstrated capability to perform worldwide missions evaluations and assessment against 60 critical categories using a fraction of the manpower at a fraction of the previous cost; development of a comprehensive concept, compatible with the Strategic Defense Initiative, of an air defense system for the United States. This work is now being refined and integrated with a Strategic Defense Architecture study underway by the Air Force; and, new systems of joint logistics and strategy mobility which provide the logistics inputs to the Joint Strategic Planning System at one-tenth previous manpower costs and one-third dollar costs. The OJCS studies program is a critical element in the overall efforts of the Joint Staff to give the best military advice at the highest levels of government. The OJCS contract studies program must be vigorously supported.

## C. OFFICE OF THE DIRECTOR, PROGRAM ANALYSIS & EVALUATION, PE 65106D

The mission of PA&E is to provide information and analyses to assist the Secretary of Defense in making decisions on the Five Year Defense Program, and associated force structures, weapon systems, and required resources. More specifically, PA&E (1) participates in the preparation of the annual planning and fiscal guidance issued by the Secretary of Defense; (2) analyzes and evaluates the forces, major programs and weapon systems proposed by the Military Departments in terms of the planning guidance and mission requirements, capability and cost; (3) independently analyzes the cost and operational effectiveness of all major weapon systems and alternatives at each milestone for the Defense System Acquisition Review Council and for Secretarial Program Reviews; (4) identifies alternative ways to fulfill the missions for which proposed forces and systems are intended; and (5) evaluates the implications of these alternatives for the Secretary of Defense. These funds are needed to provide external research and study support to the Office of the Director, Program Analysis and Evaluation.

The key objective of the PA&E research program is to assist in finding better ways to carry out defense missions and to provide the required defense capabilities with the least expenditure of resources. The specific objectives of the external study effort are to develop better data and new or improved analytical methods, identify new initiatives or long-term options, examine critical problem areas that cut across Service lines, and obtain information to support independent appraisals of critical programs.

The specific studies are usually of a short-term nature and relatively small in scope. Larger, more detailed studies are normally undertaken by the Services or other DoD components. A continuing review and dialogue is carried on with the Services in order to be mutually aware of specific study plans, coordinate study efforts, avoid unjustified duplication, and assure that studies conducted will be responsive to the needs of the decisionmakers at both the Service and OSD levels. Joint study efforts are often conducted by PA&E with the Services and with other OSD offices.

Previous studies have been very worthwhile. They have produced better data and methods for analyzing and evaluating the impact of alternative programs and have provided useful ideas and independent assessments. A few examples of past accomplishments are:

- A study of the effectiveness of alternative scout/attack helicopters in combat situations enabled us to resolve differences with the Army over scout helicopter procurement programs.

- PA&E's study of lead times is likely to be a prototype for future work on projecting lead times in defense industries, helping DoD avoid bottlenecks of the kind encountered in the late 1970s.

- Our electro-optical cost data base developed in 1982 has set the standard throughout the Department for good cost estimating of weapon systems. This data was essential to our analysis of the Multiple Launched Rocket System/Terminally Guided Warhead because of the almost total lack of cost data for analagous hardware due to new technology being employed.

- Another research effort to develop enhancements to our SIMSTAR/DMMS model enables us to model individual communications systems or entire communications networks. Based upon preliminary verification results, the enhancements to this model have greatly improved the model's accuracy and validity.

- Yet another very worthwhile study is our investigation of information on recent, selected military aircraft development programs. The knowledge gained from this research effort will enable us to better estimate the costs of all future aircraft, particularly the Advanced Tactical Fighter which is one of the most important issues facing the Department.

As indicated above, past efforts have been useful and productive for DoD. However, we need to move faster in developing better insights, analytical methods and information for use in evaluating how the missions of defense can be better planned and performed. Towards this end, the following are a few examples of the kinds of contract study efforts contemplated for FY 1987 for which $3.91M is requested.

- Cost Analysis Studies: PA&E analysts need to have consistent, homogenous data bases in order to provide the Secretary, Deputy Secretary, and the Defense Systems Acquisition Review Council (DSARC) accurate, timely estimates of weapon systems costs. We plan to update our ten year old Helicopter Cost Data Base and our Missile, Radar and Electro-Optical Systems Data Base. We also plan to continue research designed to improve Operating and Support (O&S) Cost Analysis and to identify O&S cost drivers. In addition, we plan to continue our very fruitful work on analysis of defense industry overhead costs and our efforts to derive relationships between advancing technological changes and the cost to develop future military aircraft systems.

- General Purpose Programs: In the area of general purpose forces and programs, we plan to evaluate Close Air Support Requirements from an operational viewpoint and within several scenarios. Emphasis will be placed on likely operating conditions and the unique opportunities and limitations of the close air support mission area. We also plan a NATO Air Defense/Counter Air Study to support PA&E's leadership role in a broad analysis of air defense/counter-air programs that have cross-service and international implications. Another research effort will result in analytical models/measures of readiness for all Services, data descriptions and sources needed to feed the models, and tabular and graphic displays of the readiness of selected U.S. and Warsaw Pact units for the period 1975-1985.

- Theater Assessments: We will continue research to develop a consistent and comprehensive model through which a comparison can be made of U.S. and Soviet military force modernization rates to provide an alternative methodology for the measurement of force effectiveness. Another effort will identify, measure, and assess the political, military and economic trends in the Caribbean Basin (with primary focus on Central America) through the year 2000, and analyze how these trends will affect U.S. security interests in the region.

- Strategic Programs: In this area, we plan major updates of models used to analyze strategic offensive and defensive programs. Another study will provide an independent evaluation of the ability of existing and programmed theater and tactical $C^3$ systems to meet established DoD operational requirements for connectivity, survivability, security, reliability, interoperability, and jam-resistance. The study will assess how well FY 1987-91 programs will meet DoD objectives for theater and tactical $C^3$ in the early to mid-1990s time period.

There are many important program issues that will be requiring Secretary of Defense decisions over the next year or two, and the PA&E study program for FY 1987 is designed to help provide the information, analyses and better methods to evaluate the issues and possible alternative actions.

## D. OFFICE OF THE UNDER SECRETARY OF DEFENSE (POLICY), PE 65107D

The $6.931M requested in FY 87 for this program element supports military interdepartmental studies and contract policy research projects on national security issues under the cognizance of the Under Secretary of Defense (Policy). Analytical requirements of all major policy staff components except the Director, Net Assessment, are included in this request. This request will provide the Under Secretary of Defense (Policy), the Deputy Under Secretary of Defense (Policy), the Deputy Under Secretary (Planning & Resources), and the Assistant Secretaries (International Security Affairs) and (International Security Policy) and subsidiary staff components with independent, expert technical assessments and analysis of policy options on subjects for which DoD does not have in-house expertise. The request is based on a research agenda reflecting the USD(P)'s priority concerns: improvement in US defense posture and surge capability with respect to Soviet strategic and conventional threats; correlation of US forces, policy, and strategy; strengthening of NATO political cohesion and commitments to force improvements; revitalization of regional collective security capabilities and commitment (particularly in the Middle East and Central America), arms control, evaluation of the policy implications of advanced technology defensive systems, and civic action policy and planning. Research is obtained from public and private universities, research institutes, and firms whose perspectives may differ from those of DoD, thus providing a wide range of inputs to policy development.

The FY 1987 program of research represents a selection of presently identified external research requirements for OUSD(P) components. The thrust of the research is to supplement or complement in-house knowledge on a range of issues under the cognizance of the Under Secretary of Defense (Policy). Planned studies for initiation or continuation in FY 1987 are:

- Integrated Long-Term Defense Strategy: It is increasingly unrealistic for the U.S. to attempt to evaluate long-term policy issues in isolation from one another. Interdependencies clearly exist among issue topics such as: Nuclear strategy over the long-term, particularly in the context of a defense dominant strategic environment; appropriate response to ambiguous warning (which is most likely to occur on the flanks), and a variety of cost-imposing and neutrality-imposing strategies. This study seeks to address those issues by way of considering the implications for a range of alternatives that may appear attractive for resolution of a single issue.

- Policy and Technology: A broad, long-range look at the potential impacts of technology on various policy options during the next decade, including the role of nuclear weapons, the impact of new technologies on conventional deterrence, strategic defense and other related issues where technological advances are creating new dilemmas and new policy options for decisionmakers.

- Low-Intensity Warfare: We anticipate the need to continue to expand research into the phenomenon of low-intensity conflict, including terrorism and insurgencies. The increase in low-intensity conflict not only threatens the political stability of various regions of the world (e.g., Central America and the Middle East) but also creates opportunities for exploitation by nations hostile to the United States and also directly threatens the security of U.S. personnel. Options and alternatives for dealing with low-intensity conflict need to continue to be addressed.

- Strategic Arms Reduction Talks, Intermediate Nuclear Forces (INF) Negotiations, and Space Weapons Talks Support: We anticipate the need for continued analytical support for ongoing arms control negotiations on issues in both the strategic and theater arenas. Issues for study include on-going verification policy analysis and a variety of topical assessments keyed to then-year analytical requirements.

- Policy Implications of High-Technology Strategic Defense: Much research is underway on technical alternatives for strategic defense. DoD requires a companion evaluation of the policy implications of advanced ballistic missile defense (BMD), technical alternatives, and related issues. This work supports internal analytical requirements as well as DoD's participation in on-going interagency assessments of strategic defense options.

- Emerging Technologies: As efforts continue to exploit a variety of newly emerging technologies to enhance security, we anticipate a continuing requirement to analyze and assess the policy/doctrinal implications of these new technologies and their potential impact on regional security arrangements.

- Confidence Building Measures (CBM): Research will focus on a comprehensive assessment of the military, diplomatic, and public opinion implications of new U.S. initiatives in the CBM field as well as the values and limitations of CBMs as a means to reduce the risk of a U.S. Soviet war. In addition to "traditional" bilateral and multilateral CBMs, such as advance military notifications of exercises and missile launches, and the value of unilateral measures, such as crisis management training for U.S. officials, will also be analyzed and assessed.

- Terrorism: As threats to U.S. security interests and to U.S. civilians overseas continue to increase as a result of terrorist activities, we anticipate the need to supplement government expertise on the subject with that of outside experts and consultants.

Although the initial payoff from policy studies generally is qualitative rather than quantitative, longer-term consequences can include significant budget efficiencies when studies enable policymakers to correlate policy options with technical feasibility and cost (and thereby identify opportunities for cost-avoidance). This has been a feature of a number of recent and on-going studies on the policy and cost impacts of various defensive technologies and will be a focus of additional study under our "Policy and Technology" project.

Moreover, payoffs from DoD policy studies are not necessarily limited to the defense sector. For example, seminal research on the costs to western nations arising from needless (and frequently unrecognized) subsidies implicit in financial transactions with the East Bloc was initiated and sponsored by DoD as part of our effort to estimate resources available to and constraints on defense investment by NATO and the Warsaw Pact. This aspect of Policy's research program has produced a number of valuable studies over the past five years and, along the way, has attracted interest and/or co-sponsorship by other federal agencies (including State Department and CIA) as analysts have recognized its utility beyond the parochial interests of the DoD.

Finally, policy studies frequently provide useful insights to the Congress as well as the DoD. Our on-going series of research papers on anti-Soviet national liberation movements is a notable example of such work. A number of the project's country-specific papers have been utilized by the Congress. Most recently, our study entitled "UNITA of Angola: Profile of an Anti-Marxist Resistance Movement" was requested and praised by numerous individual members as well as the Senate Intelligence Committee staff, who found the document to be an important source of information during debate beginning in January 1986, concerning aid to Angolan insurgents.

$1.739M is requested for PE 01015D to support the Deputy Under Secretary for Trade Security Policy during FY 1987. This program element funds policy studies related to international economic, trade and security policy as they pertain to the transfer and control of technology in support of the Office of the Under Secretary of Defense for Policy. Under the statutory authority of the Export Administration Act, Arms Export Control Act, and DoD Directive 2040.2, key issues must be identified and processes developed to avoid the inappropriate transfer of sensitive technology. This is accomplished through studies which provide independent, objective analysis and new ideas for achieving our primary goal of restraining the growth of the Soviet military capability.

Studies for FY 1987 will require: data collection, collation, and analysis of the Technology Security Program; examination of the relationship between computer capabilities and military weapon performance and determining their constraints; industry and technology assessment for various technologies; a country by country review of U.S. Government technology security policy will continue; development of a methodology to test our ability to control technology through transfer mechanisms or economic sanctions; continued assessment of the aggregate effect of transfers of technology, products, goods and munitions on the security of the United States regardless of the transfer mechanisms involved; state-of-the-art technology assessments between the U.S. and the Soviets; West-West export license application review procedures; further FORDTIS development; continuing development on export license application precedents; and an analysis of how the Soviets view U.S. export controls.

## E. OFFICE OF THE DIRECTOR, NET ASSESSMENT, PE 65108D

The Director, Net Assessment research and analysis program provides systematic net assessments to the Secretary of Defense and other DoD officials in the following military balance areas: Strategic Forces, NATO/Warsaw Pact, East Asia, Power Projection, $C^3$I, Maritime, and Military Investment. To enable OSD/NA to prepare these military balance assessments, a vast amount of research and analysis is required - amounts which far exceed the capabilities of in-house researchers and analysts. Contracted research focuses on studies of comparative doctrine/capabilities, Soviet methods of assessment, improved scenario development, comparative economics, and defense policy and strategy planning. Lacking the capability to contract for studies outside of the government would make it exceedingly difficult, if not impossible, to accurately assess the U.S./Soviet military competition in terms of its relation to, and impact on, alliance structures and countries throughout the world. As a result, policy and decision making throughout DoD would be significantly degraded.

OSD/Net Assessment contract studies program objectives are to: (1) provide for research that leads to better assessments of military balances; (2) conduct research on improved net assessment methodologies; and (3) develop analyses supporting defense policy and strategic planning. These three objectives are met as follows:

- Studies assessing worldwide comparative military advantages/disadvantages through the analysis of measures of force effectiveness; strategy and doctrine; organizational flexibility; command and control; training; economic detriments of long-term performance; the impact of technology; and analysis of basic doctrinal asymmetries.

- Studies pertaining to improvements in net assessment methodology and analysis are required because there are major aspects of the balances which are not now well analyzed. To adequately address these deficiencies requires the development of new methods for comparing U.S. and Soviet military force modernization rates which would provide alternative methodologies for the measurement of force effectiveness. External research provides a means through which we can evaluate and correct deficiencies and improve our capability to do first rate net assessments.

- Studies in support of defense policy and strategic planning continue to evolve in an attempt to support the increasing demand for this type of analysis as required by the Executive Branch, Congress, OJCS and Military Services.

Two examples of contract studies that meet these objectives are:

- OSD/Net Assessment has for some years funded research into the development of qualitative indices for measuring the performance potential of all recent types of conventional weapon systems. The resulting figures of merit can be used alone to demonstrate trends in both U.S. and foreign technological developments. Combined with inventory levels, they can provide better measures of relative modernization rates (and investment strategies) than simply counting numbers. Combined with equivalent estimates of personnel capabilities, command and control quality, and logistics support quality, they can provide useful static measures of changing overall force potential. Other derivatives are being developed to provide "executive level" estimates of both industrial and military mobilization potention. This "TASFORM" research is now being applied to ground and tactical air forces, and will soon be expanded to naval forces.

- The Rand Corporation recently completed a three year study done jointly with the Korean Institute of Defense Analysis, of the implications for the military balance on the Korean peninsula of the relative economic strengths of North and South Korea. Using carefully refined data, and specifically developed econometric models, the analysis shows that South Korea's economic and technological advantages over North Korea are substantial and its economic preponderance is growing rapidly, thus affording it major opportunities (highlighted in the report) to realize significant advantages in the long-term military competition. The study applies systematic and rigorous analytic methods to the data in order to support policy development, making manifest assumptions, the probable effects of alternative strategies and the sensitivity of outcomes to changes in strategies. An ancillary benefit of this effort was to help a key ally develop modeling expertise of its own to support its defense policy process.

Our FY 1987 request for $4.415M will provide for:

- Studies into Soviet style assessments and how the

Soviets view the military balance with the U.S. This research was reduced in level of effort in FY 1985 because of Congressional budget reductions. This program has now begun, but must continue at full funding because it is extremely important to national security that we understand the calculus of deterrence from the Soviet viewpoint. Being able to anticipate probable Soviet actions as a result of their perspectives is a critical component in the development of viable U.S. strategies.

- Studies focusing on the long-term military competition and deterrence with regard to the Soviet Union. Such analysis needs to address our competitive strengths and how to exploit Soviet vulnerabilities.

- Analysis of the impact and implications of weapon system technology as regards the development of important long-term national strategies, particularly with the increasing emphasis being placed on the need for more conventional capability in Europe and continuing nuclear commitments.

- Basic research into all areas of Soviet society and infra-structure to develop an understanding of the economic, political, socio-cultural, and military problems and issues which impact on Soviet defense strategy and planning. This understanding is vital to the development of U.S. strategy and defense policy planning.

## F. OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE (FORCE MANAGEMENT AND PERSONNEL), PE 65109D

The Office of the Assistant Secretary of Defense (Force Management and Personnel) requests $2.049M for RDT&E analytic and technical support in FY 1987. The Assistant Secretary of Defense (FM&P) is responsible for providing policy guidance, program formulation, and execution oversight on matters concerning total force management, military and civilian manpower and personnel matters and manpower mobilization and requirements.

OASD(FM&P) sponsors research, studies and analyses to: develop solutions to identified problems; evaluate the effects of existing policies; produce new analytical methods and models to aid in predicting the outcome of proposed new policies; and respond to Congressional and other high priority requests for information. The objective of these efforts is to provide increased capability of DoD manpower to meet force effectiveness, combat readiness and sustainability goals.

The funds requested for FY 1987 program will continue promising FY 1986 and earlier initiatives and begin new projects identified by the staff, recommended by the FM&P Research and Studies Review Committee and finally approved for funding by the ASD(FM&P). The program's main thrust will include: (1) the determination and evaluation of manpower requirements (military, civilian, and contract); (2) Total Force analysis and planning to include the issues of Total Force structure; (3) continued development and improvement of models to measure resources to readiness and sustainability; (4) military and civilian compensation analysis; (5) meeting the goal of improved personnel training to include policy oversight for the Congressionally endorsed Training Data and Analysis Center; (6) career development and retention issues that can severely alter mid and long range accession and compensation policies; (7) improving DoD mobilization and emergency planning; (8) the development of accession and compensation policies; and (9) the development of improved estimates of how military enlistments respond to various supply factors, both those originating in the civilian sector (e.g. business cycles) and those over which the military exerts some control (e.g. recruiters). Proposed research and studies also address Congressionally identified problems such as manpower readiness levels, analysis of the recruiting market available and necessary incentives to support the volunteer military force in the outyears, and improved manpower support to new and fielded weapon systems. Overall, we believe the FY 1987 program will play a substantial role in the efforts to improve the DoD readiness and sustainability posture.

The results of previous research efforts have produced new data and improved analytical methods to evaluate the effects of existing as well as alternative programs and policies. For example: (1) the enlistment bonus test showed, for the first time, that enlistment bonuses "expand" the market for high quality recruits, and do not simply "channel" recruits who would have otherwise enlisted in less critical skills. These results will be important as pay raises become increasingly scarce and alternatives are needed to attract high quality people; (2) a look at the retention effects of educational incentives shows evidence that it reduces retention instead of supporting it; (3) "high risk" research aimed at developing an officer retention model has greatly contributed to the start of an enlisted retention model that is increasingly important due to significant changes in the compensation retirement system in general; (4) an indepth understanding of recruiter incentives has provided the Army recruiting community with tools that have greatly improved productivity of recruiters at no additional costs; (5) development of an empirical data base for use in planning and designing family-related programs and improving our understanding of the role of families in retention, morale and readiness; (6) development of the information requirements needed by the OASD(FM&P) staff in support of the National Command Authority during mobilization, deployment and sustainment of our armed forces. These and many other research and studies outcomes have contributed to resolving and better understanding DoD's human resources needs. This is an important program and we seek your continued support for its funding requirements.

## G. OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE (COMMAND, CONTROL, COMMUNICATIONS AND INTELLIGENCE) PE 65116

This program element funds projects for Strategic Command, Control and Communications ($C^3$); Theater and Tactical $C^3$; Defense-Wide $C^3$; and Defense-Wide intelligence program efforts related to research and development and defense planning in support of the Assistant Secretary of Defense (ASD) Communications, Command, Control and Intelligence ($C^3I$). Projects address several complex issues facing DoD: Performance of National Intelligence Systems; changes to current intelligence programs or new system initiatives; development of an intelligence support architecture for the Unified and Specified commands; improving imagery and digital mapping capabilities; development of an international $C^3$ data base for interoperability analysis and planning; and assessment of the implementation of new technologies into various communications and data transmission systems.

The programs to be supported in FY 1987 include:

- International $C^3$ Technical Support: The International $C^3$ Technical Support program is being accomplished by the MITRE Corporation to assist the ASD($C^3$I) in developing the International $C^3$ Data Base, analyzing Munitions Cases and preparing $C^3$ overviews for interoperability analyses and planning. This effort provides OSD with a comprehensive overview of international $C^3$ activities. The data base serves as the basis for OSD/$C^3$I reviews and approvals of Munitions, Foreign Military Sales (FMS) and Commercial Consortium (COCOM) cases and must continue to be expanded. The overviews form the basis for OSD plans and actions in Third World countries.

- $C^3$ Information Systems Internetwork Study: The $C^3$I Information Systems Internetwork Study is a continuing effort by the Institute for Defense Analyses (IDA) to provide oversight over the evolution of the Defense Data Network (DDN) and several special projects and insure new technologies are incorporated into these systems. It provides analysis of these programs to assist DoD in policy deliberations. This effort will support network interoperability, utilization of Local Area Networks (LANS) and continuing efforts in protocols and data base standards for DDN. Additionally, assessment of the special programs architecture is necessary to assess program development.

- Identification of Ground Combat Units: The Identification of Ground Combat Units program is a continuing study to recommend a system architecture for ground target identification. Increased use of precision-guided munitions (PGM's) in direct and standoff attack of armored vehicles poses an increasingly serious problem in identifying friendly and enemy ground combat units, i.e., battlefield identification friend or foe (BIFF). This will assess the issue of BIFF as it affects the development of antiarmor weapons systems and associated target acquisition and command and control systems. IDA is currently performing an initial exploratory assessment of current techniques and procedures and of promising new techniques for direct and indirect identification of armored vehicles and ground combat units. This study is expected to identify several identification system options that appear promising in improving identification performance.

- Follow-On Force Attack (FOFA) Program: The objective of the Follow-On Force Attack (FOFA) program is to analyze theater-level issues for strategy/counter-strategy, force size/force mix, and existing systems/emerging technologies in the post-1990 time frame. To date, the program has had a heavy anti-armor emphasis with particular attention to assessment of joint tactical missiles (JTACM's) and other terminally-guided submunitions weapon systems; multiple launch rocket-type systems, air-delivered systems (both penetrating and standoff); and reconnaissance, surveillance, and target acquisition systems. The analyses should provide US and NATO allies with alternatives for target acquisition and $C^3$ systems. In FY 1987, the analysis will begin to assess the requirements, architectures and implications of the Battlefield Information Collection and Exploitation System (BICES) and related intelligence fusion systems on the Follow-On Force Attack Program.

- Electronic Warfare and Spectrum Management: Significant and dynamic changes in electronic warfare (EW) have occurred as a result of the experiences of recent conflicts (e.g., Falklands, Middle East), a rapidly increasing Soviet electronic threat, technological improvements, and the changing nature of warfare in general. U.S. EW capabilities in terms of hardware and tactics for employment, such as the move to high-powered standoff jamming platforms (e.g., COMPASS CALL), have put new demands on joint planners, operators, spectrum managers, and command and control systems personnel to cope with self-interference and possible electronic fratricide. Unfortunately, there is no a priori knowledge as to how a particular piece of EW equipment will operate in a geographically dependent electronic environment, and there is uncertainty as to which emitters, U.S. and Allied, might be affected by the employment of that jammer. New warfighting strategies such as $C^3$ countermeasures which depend heavily on electronic warfare, have more closely drawn together hard-kill and electronic warfare disciplines, further complicating the coordination requirements. This program examines the impact of the changing electronic warfare environment on use of the electromagnetic spectrum by U.S. military forces; defines the need for improved EW mission planning and coordination, focusing on how theater commanders and joint task forces can best organize and implement electronic combat plans to facilitate EW and $C^3$CM coordination and improve overall spectrum prevention of electronic fratricide, both from a technical as well as an operational viewpoint; and assesses the adequacy of existing $C^3$ data bases to support modern EW deconfliction and $C^3$CM battle management.

- Intelligence Architecture Studies and Support Plans: Intelligence Architecture Studies and Support Plans program develops intelligence support architectures for the U&S Commands under DIA's overall Theater Intelligence Architecture Program (TIAP). This architecture effort involves defining and examining command, control, communications, and intelligence relationships and capabilities for tactical intelligence systems, beginning with Army echelons at corps and above, Air Force wings and Navy battle groups. The results of this activity will provide detailed information for inclusion in the DoD Planning, Programming, and Budgeting System process. It will also support development of the DIA/JCS Defense-Wide Intelligence Plan which is the principal DoD long-range planning document for intelligence needs across both national and tactical programs. The emphasis in this effort is on satisfaction of EUCOM wartime intelligence support requirements. In FY 1986 in conjunction with EUCOM, a series of draft functional sub-architectures are being developed. Further a conceptual Allied Commanders Europe (ACE) Interface Architecture (AIA) that outlines a core intelligence structure for supporting U.S. and NATO/SHAPE requirements is also being developed. In FY 1987, the planned activities involve a continuation of the defining and examining of command, control, communications and intelligence relationships and capabilities for tactical intelligence systems. As part of this process, the draft sub-architectures developed in FY 1986 will be further developed and refined. The AIA will also be expanded to obtain greater detail in operational requirements along with a recommended phased implementation plan. This initial ongoing effort has been extremely successful in developing an effective planning focus and methodology; so much that DIA has expanded the effort to include all of the Unified and Specified Commands under the

Theater Intelligence Architecture Program (TIAP). This activity will provide detailed information for inclusion in the DoD Planning, Programming and Budgeting System process. It will also continue to support development of the DIA/JCS Defense-Wide Intelligence Plan. As importantly, these architectures are defining evolving theater command relationships and responsibilities that are required to support an effective intelligence support capability.

- OSD Imagery Acquisition and Management Plan (IAMP): The OSD Imagery Acquisition and Management Plan (IAMP) addresses the capability to collect imagery from national imagery collection systems and disseminate it to theater and tactical users via an improved distribution system. Contractor support was required to analyze and harmonize significant amounts of technical data provided by numerous government agencies and to physically produce the IAMP. Previous IAMP efforts were instrumental in developing the in-depth information and design details necessary for obtaining approval of the distribution system and emphasize the receipt and exploitation systems mix necessary to meet imagery requirements of operational forces and the communications capabilities and limitations will be assessed; and new and emerging technologies that could be applied to this problem set will be identified. Results from the study will be used to recommend changes to current intelligence programs or new system initiatives. Planned activities involve focus on secondary dissemination and the potential commonality in the development of imagery sensors, data links, and exploitation equipment for tactical systems.

- Digital Mapping, Charting and Geodesy Interoperability Study: The Digital Mapping, Charting and Geodesy Interoperability Study addresses the growing need for digital MC&G data in the intelligence and DoD operational communities as well as the mechanisms to satisfy these needs with data derived from the operations of the DMA Modernized Production System. The object is to refine digital spatial data structures and operating procedures so that, by the mid 1990's, electronic Earth information serves as a metrically accurate foundation for digital spatial intelligence data such as orders of battle and installations. These data, Earth information and overlaid intelligence in interoperable data structures, may then serve as a unified basis for integrated force planning and execution.

## H. OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE (ACQUISITION AND LOGISTICS), PE 65119D

The Office of the Assistant Secretary of Defense (Acquisition and Logistics) requests $3.263 for RDT&E analytic research and technical support in FY 87. The Assistant Secretary of Defense (A&L) has the general mission to provide policy formulation and management oversight of all acquisition and logistics support in the Department of Defense. This is accomplished by establishing policy and procedures with goals and objectives for use by the DoD components in determining requirements and managing the resources to meet these requirements. The funds provided in this program element provide the capability to initiate, direct and complete studies and analyses to aid in solving near and long-term problems. They allow the Secretary to respond to Presidential and Congressional requests when expertise is not readily available; and to provide increased capability of DoD to meet its objective of combat readiness and sustainability goals. These studies and analyses efforts are concentrated in high priority areas and performed by organizations external to DoD but closely monitored by the OASD(A&L) professional staff who act as project sponsors. The A&L program supports five major areas of research in FY 1987:

- Production Support: Major projects that are addressed in this area are streamlining the management of the acquisition process; developing testing techniques to effectively measure defense contractors' productivity gains and determine appropriate incentives/rewards; and improve the Industrial Preparedness Planning Program which is designed to ensure that the U.S. industrial base is able to respond to peacetime and national emergency defense production requirements.

- Procurement: As our statutorily required Small Business Innovative Research Program (SBIR) increases as mandated by law, improved procedures need to be developed and ultimately implemented. A task is underway to review current program responsibilities and recommend system improvements to meet the requirements.

- Logistics and Material Management: The primary thrust of these studies and analyses is to improve overall management of logistics and in turn improve combat readiness and sustainability. The major tasks being undertaken are: development of Energy Estimating Relationships; development of a pilot system for electronic exchange of government bill of lading (GBL); reduce the growth of secondary item inventories; develop estimates of depot maintenance requirements in the 1990's; develop methodology for determining wartime air container movement requirements; improve the accuracy of material demand forecasting and develop standardized reliability centered maintenance decision methodology.

- Spares Program Management: The Spares Program is undergoing review in order to improve its overall function. Specific tasks undertaken within this program are: procurement leadtime reduction; improvement of analytical techniques for evaluation of spares funding and evaluation of private sector management techniques for potential implementation within DoD.

- Installations: DoD contracts yearly for over 1,000 major military construction projects. Many of these projects are of a recurring nature with similar requirements. Thus, an assessment of the desirability of adopting standardized design features for selected DoD facilities is in progress. Another emphasis within this part of the program is to increase the efficiency and effectiveness (productivity) of the base operating support. If this could be improved, significant resources could be released for other applications.

The planned program request for FY 1987 reflects the myriad of complex issues and dynamic problems facing the Department, both in the long and short run. The tasks highlighted above are designed to examine and assess the implications and consequences of current and alternative policies, plans, operations, strategies and budgets; understanding and gaining insight into complex multifaceted technological, military and acquisition environment in which defense decisions and opportunities will be posed, considered and evaluated.

Mr. PRICE. Mr. Krings, we are pleased to have you testify before our subcommittee for the first time. Before you begin, I would like to recognize our ranking member, my friend and colleague from Alabama, Mr. Dickinson.

Bill.

Mr. DICKINSON. Thank you, Mr. Chairman.

Mr. Krings, we would like to welcome you for your first appearance before our subcommittee and look forward to your independent assessment of the critical defense programs.

I notice in your statement that you have oversight responsibility for some 150 weapons programs. Some have felt that you have 15 professionals assist you in oversight, and I wonder why you need all these people.

We have oversight here of about a thousand different line items, and we do battle with the House Appropriations Committee, then we go to conference and do battle with the Senate, and we only got two staffers. I think you are overloaded over there.

But anyway, if you don't stumble over each other, I guess that is all right.

I am particularly interested in the results of your participation in the DSARC's on a number of programs to include AMRAAM, SUBACS, ASAT, HARM among the many that you have oversight over. Again, we are very pleased to have you with us today, and we will put on the pillow gloves today and get tough later.

You may proceed.

## STATEMENT OF JOHN E. KRINGS, DIRECTOR, OPERATIONAL TEST AND EVALUATION, DEPARTMENT OF DEFENSE

Mr. KRINGS. Thank you, gentlemen, and thank you, Mr. Chairman, for the opportunity to be here in my first visit in an official capacity. I would first like to submit a statement for the record.

Mr. PRICE. That will be printed in full in the record.

Mr. KRINGS. I think that your staff should have received that at least yesterday morning and conceivably just before the weekend. I am not certain.

I would like to talk no more than about 10 minutes and just reacquaint you with what we are doing and what we do and spend the greater portion of the time answering your questions that will certainly include the question of our activity in DSARC's with respect to AMRAAM and the list of particular weapon systems that you brought up.

I would like to take this opportunity to introduce my three deputy directors, whom I have with me today. The first one is Don Greenlee, Deputy for Plans and Programs, he has had extensive experience in and outside the Defense Department in testing and evaluation and brings quite a bit of credibility and experience to our organization.

Second, Gen. John Schoeppner, our Deputy for Operations. John is a test pilot, has been in the operational test business for years and comes to us from Eglin Air Force Base with a lot of recent experience in operational testing.

Third is Karl Pflook, our Deputy for Policy, Resources and External Affairs. He is one of you; he comes from the Hill and he has been a very valuable asset to us in our relationship with the Congress and the various congressional committees and staff people. He understands so much more than we do in that respect, and we are fortunate to have him.

I would like to go through just a few slides so we understand what we do and what we are trying to do, and I will try to get through that quickly, I know some of you are very familiar with our activity.

The Congress, as was mentioned before, created Public Law 98-94 making the Director of Operational Test and Evaluation an Assistant Secretary of Defense level job. As you all know, in the Defense Department, in the Pentagon, if you are a "Director" and are, in fact, to be an ASD, it counts as if you are an "ASD lower half." One of the services does it that way.

We are independent. The law was written very, very effectively. Every time we run into a controversy, it seems to me the law is very explicit and handles our situation very well.

We have direct access on a daily basis when necessary to both the Secretary of Defense and to the Members of the Congress, and the staff of the Congress has reciprocal direct access to us, as does the Secretary of Defense. So it works as advertised and as planned.

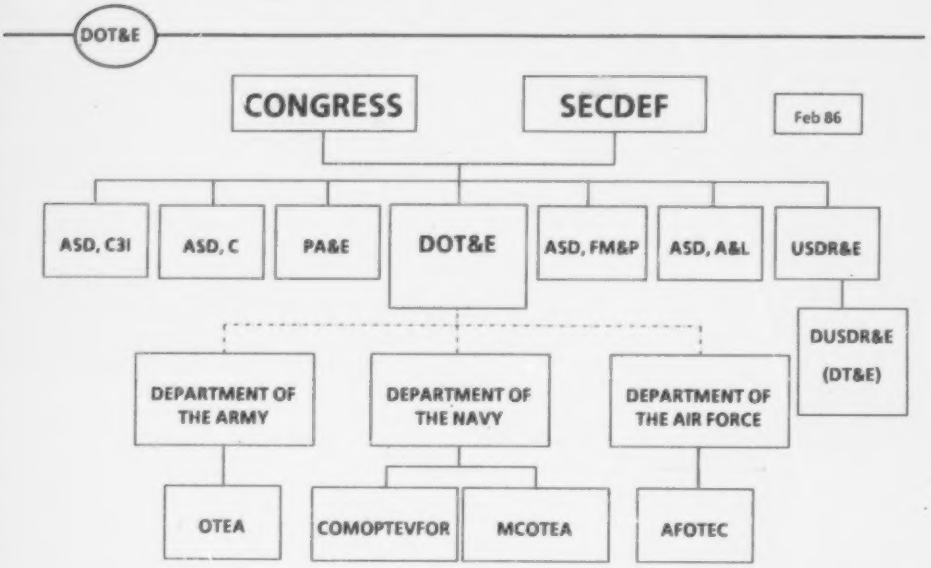
Obviously the military departments are the ones who really do the operational test and evaluation. They do the planning, they do execution, and they do their own reporting. So they are really the active organizations.

We approve the adequacy of the plans and we observe the activities, and then we do really two reports, an annual report that gives the status of the ongoing programs, not with respect to their operational effectiveness but with respect to the status of the program—how it is going and if it is going well in terms of accomplishment.

At the end of each major operational test in which the decision is to be made to go beyond limited low-rate initial production and go to full-rate production, we submit a document, a report to the Congress and to the Secretary of Defense, with our observations and our recommendations, and our evaluation.

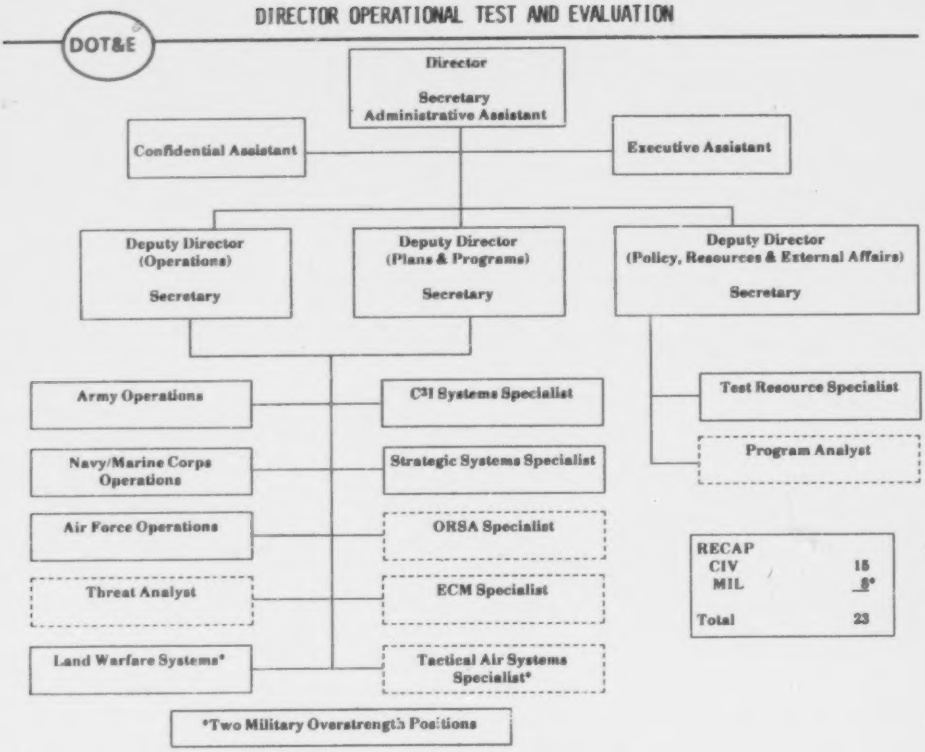
We look after all DOD policies pertaining to operational test and evaluation. That includes threats, multiservice tests, et cetera.

## OT&E ORGANIZATIONAL RELATIONSHIPS


DOT&E
CONGRESS
SECDEF
Feb 86
ASD, C3I
ASD, C
PA&E
DOT&E
ASD, FM&P
ASD, A&L
USDR&E
DUSDR&E (DT&E)
DEPARTMENT OF THE ARMY
DEPARTMENT OF THE NAVY
DEPARTMENT OF THE AIR FORCE
OTEA
COMOPTEVFOR
MCOTEA
AFOTEC

As you can see from this chart, we work for both the Congress and the Secretary of Defense; we are on par with the rest of the ASD's and USDRE's and indirectly we work with the Departments of the Army, Navy, and Air Force.

In terms of operational testing, we advise them and make suggestions to them and write policy guidance when necessary.

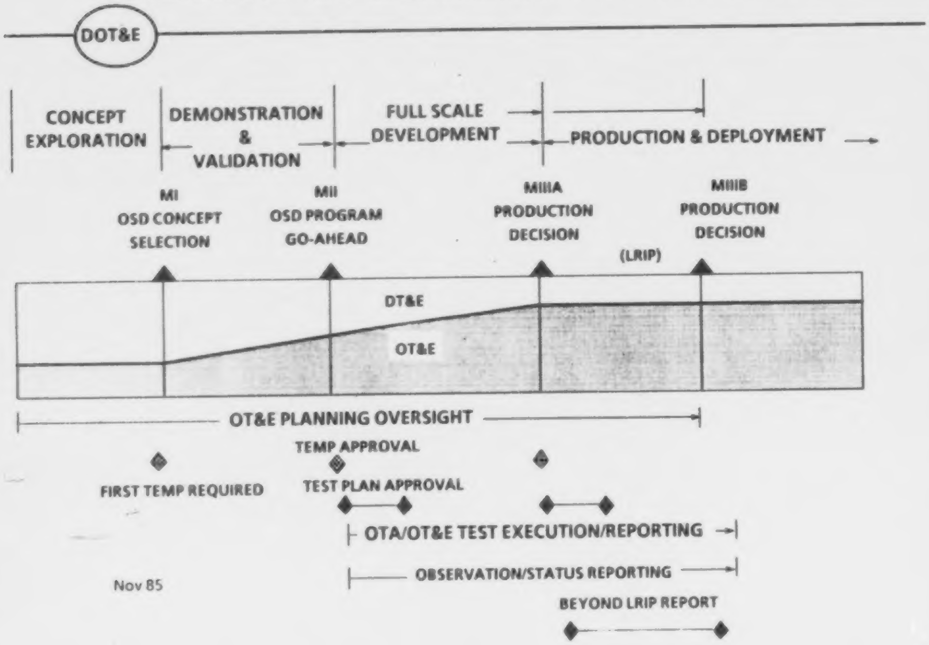

DIRECTOR OPERATIONAL TEST AND EVALUATION
DOT&E
Director
Secretary
Administrative Assistant
Confidential Assistant
Executive Assistant
Deputy Director (Operations)
Secretary
Deputy Director (Plans & Programs)
Secretary
Deputy Director (Policy, Resources & External Affairs)
Secretary
Army Operations
C3I Systems Specialist
Navy/Marine Corps Operations
Strategic Systems Specialist
Air Force Operations
ORSA Specialist
Threat Analyst
ECM Specialist
Land Warfare Systems*
Tactical Air Systems Specialist*
Test Resource Specialist
Program Analyst
RECAP
CIV 15
MIL 8*
Total 23
*Two Military Overstrength Positions

Our organizational chart will make this clear; the three deputies with us today, the rest of the people are on an equal status. It is like a matrix pool of people we put together ad hoc for each program, whatever is necessary. It is not a vertical organization. It is really a horizontal organization in which all these people operate as a group or independently, depending on the program in which they are involved.

As you can see in the recap, we have 15 civilians and 8 military, which includes 2 overstrength positions, giving us a total of 23 people.

I will be glad to discuss in a moment with all of you the numbers of people and how we do things.

DOT&E RESPONSIBILITIES/AUTHORITIES IN THE ACQUISITION CYCLE


DOT&E
CONCEPT EXPLORATION
DEMONSTRATION & VALIDATION
FULL SCALE DEVELOPMENT
PRODUCTION & DEPLOYMENT
MI
OSD CONCEPT SELECTION
MII
OSD PROGRAM GO-AHEAD
MIIIA
PRODUCTION DECISION
(LRIP)
MIIIB
PRODUCTION DECISION
DT&E
OT&E
OT&E PLANNING OVERSIGHT
TEMP APPROVAL
FIRST TEMP REQUIRED
TEST PLAN APPROVAL
OTA/OT&E TEST EXECUTION/REPORTING
OBSERVATION/STATUS REPORTING
BEYOND LRIP REPORT
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Most of you are probably more familiar with this chart than I am. This is how we go through this acquisition cycle and the role we particularly play within it. Along the top are the phases—concept, demonstration, full-scale development, et cetera. Under that are the milestones and then the events that occur in each of the milestones. Under that is the testing activity, the white part being development and engineering testing, the gray part being the operational testing and assessments of its effectiveness and suitability.

As you can see, operational testing begins very early in the life of a program. If one were to develop this chart some time ago, you wouldn't see the gray area start until milestone 3B, prior to production decision. But we are getting in much earlier; we must get in much earlier and develop the proper perspective so that production decision can be made properly, and if there is any deviation from the plan, we can find it earlier rather than waiting until the item is quite mature.

The bullet you see called the "first TEMP required" is a test and evaluation master plan. We are finding that to be a very, very effective control tool to discipline the acquisition process. The first TEMP is required to be present and completed before milestone 1. This means basically, that the program cannot go from concept exploration to demonstration and validation if you really don't know what it is supposed to do in the long run; and if you know that, you should be able to write a plan that will evaluate it.

So it precludes programs from getting too far down the line when in fact they don't have a focus on the requirements and a focus on the demonstration of the requirements.

That is reviewed all the way through the life of the program to ensure that we keep in focus what it is supposed to do and don't let it creep into other areas.

So that test and evaluation master plan now, TEMP, has become quite a good control tool for controlling the events within the acquisition cycle of a given piece of equipment.

We and the USDRE approve all the TEMP's and updates of the TEMP's as we progress through acquisition.

I have recently instituted a requirement to review these TEMP's annually. If there is no change it is simple; if there is a change then the TEMP should reflect the change in the program and a test commensurate with that change. So we keep up to date with what we really want in the long run at the end of the program.

The last event is beyond the low rate initial production report. That is the most significant test event in the life of the program because it says whether an item goes into production or not. That is done at the milestone 3B production decision, after the report from our particular organization.

The next slide shows that as we were instructed with creation of the organization, the adequacy and realisms of tests is a key ingredient which we are pursuing vigorously.

DOT&E AND THE "FINAL EXAM"

Tests: Adequacy, realism, IOC threat.
Independence: observation, assessment, reporting.
Follow-up: verification, improvement.

When we look at the adequacy of a test, we are trying to ensure that there are enough dollars to do it, that the proper threat is being looked at, that there is in fact a user participant who represents what the user will be like when the item is fielded—and that tests are challenging. That there is enough testing, not too much and not too little testing.

I think sometimes we have erred on both sides. We are focusing in on enough testing.

Realism is a key issue. Realism isn't always necessarily taking the production item and going out into the field and testing it. That may in many cases be entirely too late in the life of the program; it may be unsafe to do and it may be unsecure to do. For many reasons we are using alternative methods to do operational testing through the life of the acquisition program, which includes simulation, et cetera, with a credible real-life balance to insure the simulation doesn't represent something other than what we really want to do.

Obviously, security and safety considerations often play a big role in using something other than the real thing. The IOC threat in this particular case—we want to be sure we are dealing with the real world that is going to exist when the weapons system is fielded, not a vintage-type threat that is easily overcome.

Independence—again, I cannot say too much about the legislation because it really created a truly independent organization. We have observed many tests; we are welcome as observers during the military tests; we have had no problems executing that particular portion of our activity.

One of the items that you spoke about earlier was numbers of people. The one concern that we have is that there is a shift from the traditional technique of doing an operational test that is condensed and over with rather quickly, to continued operational testing which lasts a lot longer time and is done on an intermittent basis as opposed to a dedicated basis. This we are finding is going to require closer scrutiny and perhaps ultimately more people.

The assessment is done and as you well know, with the number of people we have, we cannot do the entire job. So we have contract help. The contract help does the job of putting the data together, but as you can imagine, they are not involved in the making of the judgments and outcomes and evaluation.

We are trying to create an organization or an opportunity to follow up to ensure that when the weapons systems do in fact get fielded, that anything that is found later on is fed back into the system, and we don't make the same mistake twice.

We have had an effect on the test and evaluation master plans. There have been changes, and we are using the TEMP in a role of control to discipline programs to ensure programs don't go off in the wrong direction.

Effects on operational test plans have been very significant. They are much more rigorous. Really, it allows in many cases the military operational tester to do what he might have done anyway if he had not gotten a lot of "advice" on how he should really do the test.

So we don't really find that there is any inability within the military to prosecute and suggest a proper test. It is just that there is a second opinion now as to what should be done.

We mentioned before we are observing but we may not have enough people to do it under the combined DOT programs coming along now. Threat upgrades obviously require money. We are trying to create a system that will better project what we need in the future, so we don't get caught short with inadequate equipment to do the proper testing. Obviously, outlays have to be generated well in advance of that so your support may be needed in those areas.

In test support and facilities review, we are reviewing all the facilities that we have to make sure we are exploiting them properly and that they are efficient. There are a lot of facilities in the test and evaluation world that we think could be better used, through joint use or multiple use. Certainly with new equipment we have to take into consideration its use in development and operational tests, and in training. Hopefully we can bring a little more productivity and efficiency to some of the pieces of equipment that will be acquired in the future for testing.

DOT&E IMPACT

DOT&E

EFFECT ON TEMPS
EFFECT ON OT&E PLANS
OBSERVERS
THREAT UPGRADES
TEST SUPPORT & FACILITIES

DIVAD
AHIP
AV-8B

THIRD ANNUAL REPORT
SERVICE OT&E BUDGETING
DSARC • DRB • SPR

These are three major programs that we have been involved in, to give you an assessment, a view of what we have been doing. The DIVAD Program, Sergeant York, that many of you are familiar with the Secretary of Defense elected to terminate as a result of some of the results of operational testing.

The AHIP, which is a Bell-produced helicopter that had three roles, scout and cavalry and artillery director. One of the roles was satisfactory, the other two didn't meet the operational effectiveness requirements. There was certainly a consideration of the training and capabilities of the people that were involved and how it was used.

So they are going to go back and do another test without really altering the helicopter, but altering the way it is employed, and perhaps we will see better success. At the present time, the acquisition is being limited to helicopters only in the role in which it was successful.

The other program is, AV-8B, Harrier, for the U.S. Marine Corps. It was given an effectiveness and suitability rating that suggested to the Secretary of the Navy that he go on and authorize acquisition of that particular item.

We put out our third annual report; it is a classified report. There will be an unclassified version that will be out by the end of next month, I believe. We are interested in service OT&E budgeting for the reasons I mentioned before. As a member of the Defense Resources Board, I can bring a little pressure to bear at the end of the season to assure that any items that may not have made it through a service POM in terms of testing can be brought up again at that time.

We are involved in the DSARC's, all of the DSARC's, and in fact we have been invited to service reviews when the service review will end in a recommendation on high rate production.

Again, using the presence of a test and evaluation master plan in the DSARC, that can bring perhaps a little more discipline to the acquisition process.

I am involved in the Secretary of Defense program reviews, SPR's, and he has chosen to use us as an advisor to him in many cases for an independent report.

At this point I must mention that probably our strongest supporter in the Department of Defense is Secretary Weinberger. He views us literally the same way as the Congress does. In many, many cases, we are asked to give counsel to him in areas in which operational testing really has not begun yet, but he thinks that we might have an insight or projection of what the operational capability will be.

He has been incredibly supportive, and probably, he is our most significant supporter in the Department of Defense in all ways.

So the bottom line is, we were given an organization that everybody would like to have. There were no rules when we started, there was no history when we began, and therefore there are no excuses for what we do. We can never blame anybody for anything that we do wrong because nobody controls us. We didn't inherit anything and there were no rules to start with.

If we do it well, we can stand up and be counted. If we do it poorly, only we can be criticized because we have no one else to blame it on.

As you can see, our primary loyalty is to the user, the service man or woman who is ultimately going to have to depend on the equipment to be successful in combat.

There is also a secondary responsibility that we certainly recognize, and that is a responsibility to the taxpayer to ensure that he doesn't pay too much for what he gets. Certainly he pays enough. We wouldn't want him to pay too much. There has to be a responsibility to the free enterprise system; industry does have to make a profit if they make a good product. We cannot build anything without them.

In our budget, which is our next page here, we request no changes or alterations whatever. We would like to believe that our fiscal year 1987 number will go through unscathed, but we are realistic.

We made a suggestion that our fiscal year 1987 and subsequent budgets be RDT&E money as opposed to O&M money, which gives us more latitude in accomplishment of the tasks we have to do. That has been agreed upon, and the 1987 number is in the RDT&E appropriation as opposed to O&M as it was previously.

That pretty well finishes my planned presentation, and I would be more than glad to answer any of your questions. I could start out if you want me to about some of the subjects that Mr. Dickinson brought up.

In terms of DSAR's, we are involved. I am involved as a Department staff person, as opposed to having a great insight to operational testing that has already been done.

AMRAAM is a perfect example. There have been four shots. They have some operational nature to them, but they cannot be classified really as primarily operational tests. However, it does give us some insight. That is a particular program in which our judgment and our opinions are asked for by the Secretary, but we really are not wearing our operational test hat per se because the operational testing has not been done.

There will be, however, adequate operational testing done before any major decision is made with respect to high rate production. The AMRAAM Program has very definitely a large component of operational testing during development that will ensure that we have had adequate opportunity to gain that sort of insight.

Another program that you mentioned is SUBACS. This is a forecasting game. As you can well imagine, since SUBACS and submarines are built at the rate they are built, it is not the case of taking a production item, doing an operational test, turning the switch on and building 100 of them. You make one and hope you did it right, and try to build another one and hope to do it better.

We are resorting to a more sophisticated technique of forecasting, to look at simulation and other tools that might be used in the absence of a piece of equipment to rigorously forecast the operational capability of the SUBACS system, the SSN-21 and other undersea equipment, that just cannot possibly be done on an operational basis before you make a decision.

There will be adequate operational testing done, but in the case of an item like this, it is done after the fact as opposed to before the fact.

Other pieces of equipment that have gone through operational testing before our creation I am reluctant to criticize because I don't know what pressures may have existed at that time. I would be more than glad to comment on ones that we have done and on tests that we are approving.

Ones that have been done before, I would be reluctant to comment on because I don't know truly what the rigors of the test were, and when the tests were approved, there was a different person approving them.

[The statement of Mr. Krings follows:]

## PREPARED STATEMENT OF JOHN E. KRINGS

Mr. Chairman, Mr. Dickinson, members of the subcommittee--I am delighted to be with you today. I have been looking forward to this opportunity to give you a progress report on the work of my office since my confirmation last April and to share with you my ideas on the role of operational testing in the defense acquisition process. Thank you for asking me to appear before you.

In its short lifetime, the office of the Director, Operational Test and Evaluation (DOT&E), has had a significant positive impact on the acquisition process of the Department of Defense (DoD), to the benefit of the taxpayers and our forces in the field. We are doing the job Congress called for, and I believe we are doing it well.

Simply stated, that job is to apply rigorous, independent oversight to operational test (OT) matters to help keep the DoD acquisition process focused on its overriding goal: fielding cost-effective weapon systems and equipment that work and are available when and where they are needed.

I am convinced that this requires the earliest possible OT involvement in the process. It also requires realistic OT. This in turn requires realistic representations of the threats and environments which systems and equipment will encounter when they are fielded. None of this is possible without long-range planning for OT and OT resources and the necessary budgetary and institutional support to make them available when needed.

### Test and Evaluation Planning Oversight

DOT&E is using its authority under the law to approve and disapprove Test and Evaluation Master Plans (TEMPs) and OT plans to assure that OT concerns and requirements are incorporated early in the life of new programs. We are also reviewing TEMPs and test plans for existing programs to assure that they, too, adequately address OT requirements.

During FY 1985 DOT&E reviewed TEMPs and detailed operational test plans for many programs, including:

Ground Launched Cruise Missile (GLCM)
Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN)
Army Helicopter Improvement Program (AHIP)
ALQ-131 Block II Jamming Pod
M1E1 Service Ammunition
DIVAD (Sgt York--four separate iterations)
Joint U.S. Chemical Warfare Retaliatory Capability Test (JCHEM)
T-46A Next Generation Trainer
Joint Surveillance and Target Attack Reconnaissance System (JSTAPS)
Close-In Weapon System (CIWS)
Advanced Tactical Fighter (ATF)
Pershing II
Mk-50 Torpedo
DDG-51 Guided Missile Destroyer
Mark XV Identification Friend or Foe System
Carrier Helicopter
T-45TS Trainer
LSD-41 Class Landing Ship
Inter-Service/Agency Automated Message Processing Exchange (I-S/A AMPE)
V-22 (JVX)
F/A-18
SSN-21 Class Attack Submarine
Landing Craft Air Cushion (LCAC)
AN/SPY-1B Radar (AEGIS)
HARPOON

Special Operations Force (SOF)
Long-range Rotary Wing Mission System
E-2C Upgrade Program

These reviews, a number of which included several iterations of the same program, resulted in 17 approval actions and 16 comment, change, or disapproval actions.

Two areas receive particular attention during DOT&E approval reviews. The first is test-resource planning: Are they planning for everything they need for realistic tests? Will the necessary resources be ready and available on time?

The second is threat planning: Do the plans call for testing against system IOC (initial operating capability) threats? This is critical to our success in acquiring systems and equipment that will be effective against the threats they will face when they are fielded.

Under the DOT&E plan-approval authority and in cooperation with the Under Secretary of Defense for Research and Engineering (USDR&E), I have established a policy of requiring regular TEMP updates. The purpose of these updates, which must be submitted to me and to the USDR&E for review and approval, is to assure that factors bearing on the success of a program (e.g., the discovery of a new, more potent IOC threat; requirement or concept refinements; technical or funding problems) are being taken into account and that test-resource planning and acquisition are proceeding satisfactorily.

Secretary Weinberger has been apprised of this TEMP update and review and approval policy, which will be set forth formally in the newly revised DoD Directive 5000.3, "Test and Evaluation." Under the new "rules of the road," no program may proceed to a Defense Systems Acquisition Review Council (DSARC) or Service

SARC review unless it has an up-to-date TEMP approved by DOT&E and USDR&E.

## Operational Test Resource Management and Investment

When the Services' independent operational test and evaluation (OT&E) organizations were formed in the early to middle 1970s, the implementation philosophy was to provide for independence without duplicating existing test resources. Consequently, the management and ownership of test resources has, in the main, remained with the Service R&D management organizations and their developmental test centers. This management philosophy is a logical extension of the DoD budget principle that all RDT&E-related efforts should be funded from the RDT&E appropriation. Central management of test and evaluation (T&E) resources by the Service R&D management organizations facilitates the implementation of this principle and minimizes the possibility of duplication within a Service. Moreover, it does not place an operational test organization (OTO) in competition for resources with or make it subordinate to the Service R&D management organization, thus preserving OTO independence.

The Service OTO is, therefore, a user of available test resources, as are the developmental testers. Day-to-day resource management is, then, a question of scheduling. Since the Services generally handle scheduling problems very well and initial OT&E (IOT&E) is usually accorded a priority over other competing uses, conflicts are few.

Long-Range Planning (15-20 years). This is another matter. Continuing improvement in test realism requires a rigorous, comprehensive, long-range T&E planning process. New test capabilities required for the late 1990s and early twenty-first century should be included in Service test-capabilities-development lines now. While some T&E resource planning is carried out within the Services with varying degrees of thoroughness, the OTOs are not involved, and what planning there is, is rarely long-range. I expect a DOT&E review of Service test resource planning procedures to be concluded by the end of the second quarter of FY 1986, whereupon I will issue appropriate direction to encourage long-range OT&E resource planning by the Services.

Day-to-Day Management. In execution, the RDT&E appropriation funds the direct costs of both IOT&E and developmental T&E (DT&E). However, follow-on OT&E, which is conducted subsequent to acceptance of a system for operational use (i.e., after IOT&E), is funded by the O&M appropriation for direct costs and by the procurement appropriation for investment expenses (e.g., for test articles). This division of funding derives from the aforementioned budget principle for RDT&E funding. IOT&E contributes directly to the development of the weapon system. Accordingly, test articles and other support costs of IOT&E are funded from the RDT&E appropriation. Pilot production costs for end-items not accepted for operational use, but necessary to provide representative test articles, are also funded from RDT&E. Conversely, equipment, munitions, and items that are already in routine production are provided from stock without reimbursement from RDT&E.

Implementation of the above guidelines varies somewhat from Service to Service. For example, the Air Force and the Navy both require direct IOT&E costs to be funded in a weapon system's RDT&E program element (PE). The Army centrally funds IOT&E costs in a single RDT&E PE, which contains many project lines; however, this funding may be supplemented from a weapon system PE if the need arises.

Cost of OT&E. A discussion of resource management would not be complete without addressing costs. Service cost reporting for IOT&E differs considerably both in types of costs (e.g., tanks versus ships versus aircraft) and rigorousness of accounting.

For example, as I indicated above, the cost of resources that are provided for OT&E without reimbursement is not assigned or prorated to IOT&E by any Service. In addition, items that support both DT&E and IOT&E are usually charged to DT&E as the first user. In any event, costs cannot easily be normalized or compared among the Services. Further, as the results of an Air Force survey indicate, recorded IOT&E costs are such a small percentage of the total development cost of a weapon system (generally less than 1-2 percent) that they are not an issue within the Service. Representatives of other Service OTOs have indicated that, intuitively, they would expect to find similar results.

In isolation, IOT&E costs (funding), do not constitute a useful management indicator. However, the broader view of resources required to support an IOT&E program (e.g., flying hours, steaming time, TDY manpower, rounds of ammunition) in the context of an approved TEMP or test plan, is useful. New direction requires annual updating of TEMP resource annexes regardless of any change in the plan content. The resource annex (a fiscal year spread sheet) will become a key indicator of potential OT&E program changes. For example, resource changes frequently occur outside the acquisition and T&E planning processes. Therefore, a change in available or planned T&E resources may actually precede a T&E plan content change, indicating the need for a review of the plan.

I consider oversight of the resources supporting OT&E programs to be an effective management indicator that will be of great value in evaluating the adequacy of Service OT&E plans. To facilitate this, the OT data base being designed for DOT&E will include analytical algorithms that will make possible meaningful comparison of OT&E program resources from one year to the next.

OT&E of Space Systems. The advent of the Strategic Defense Initiative and the growing importance of manned and unmanned space operations, both military and civil, mandate a more intensive role for OT&E in the acquisition of space operating systems. Consequently, DOT&E has undertaken two initiatives. First, a study has been commissioned to examine current T&E methodology for space systems and to postulate new, more active OT&E involvement. Second, USDR&E (lead) and DOT&E, with the participation of all interested DoD and non-DoD agencies, are conducting a joint review of the requirements for testing capabilities (DT&E and OT&E) to support space-systems acquisition. The objective is to have specific recommendations for OT&E methodology changes and a DoD space-test baseline requirements definition ready for the FY 1988 budget.

Operational Test Resource Investment Strategy. My office also has underway a detailed survey of existing test resources and capabilities which support OT. It is my objective to clearly identify the strengths and weaknesses of the nation's capability to conduct OT. This will provide the basis for recommendations I will make later this year to the Secretary and the Congress for a equitable DoD test-investment strategy to improve our ability to do effective operational testing.

Embodied in this investment strategy will be a balance among efficiency, effectiveness, and operational realism. Antiquated facilities and capabilities will be retired, new approaches and methodologies for testing will be sought out, and options for combining Service capabilities and eliminating unnecessary duplication to achieve a better overall DoD capability will be examined. Nothing is beyond improvement, and imaginative, innovative approaches will be critical to the success of this effort.

## Early OT Involvement

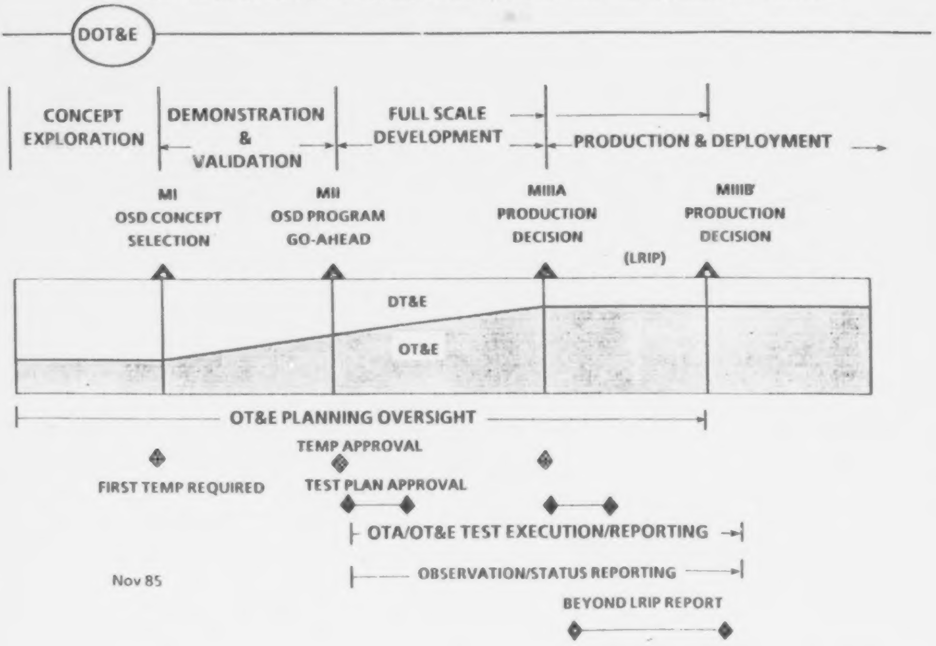
As I noted at the outset of my remarks, the earliest possible involvement of the OT community in the acquisition process is vital. Operational testing is more and more becoming a matter of forecasting. The traditional, or "final exam," approach of waiting for a production-representative item and operationally testing it just prior to going into production is today not usually sufficient, particularly for highly concurrent programs. In the main, this approach serves to identify the system deficiencies that will either carry forward into production or result in cancellation of the program.

The "down in the dirt" test, fix, test approach is not adequate either, because it tends to exclude new technology and unacceptably extend the acquisition process--and may ultimately result in what I call government-certified antiques. Certainly, a final phase of down-in-the-dirt OT is required to verify operational effectiveness and suitability, but today and in the future this is and will be but the last in a series of OT assessments.

Thus it is essential to forecast, to make assessments of operational effectiveness and suitability from the onset of an acquisition program and continually throughout its life. This is extremely difficult, but I know from long personal experience that it can and must be done. Truly candid projections of operational utility can be made with very high confidence through sophisticated simulation, combined operational and developmental testing, and fair, disciplined, timely, and independent evaluation and reporting by this office and the Service OT agencies.

Another element of early OT involvement is a new emphasis on OT&E participation in planning and evaluation activities prior to a program's Milestone II, or full-scale development, review point. To facilitate this, the requirements of DoDD 5000.3 and DoD Instruction 5000.2, "Major System Acquisition Procedures," for a program briefing of the Deputy Under Secretary of Defense for Research and Engineering (Development Test and Evaluation)--formerly DDT&E--at least three weeks before Milestone I and II reviews have been modified to require joint briefings hosted by my office and DUSDR&E(DT&E). These

## DOT&E RESPONSIBILITIES/AUTHORITIES IN THE ACQUISITION CYCLE


DOT&E
CONCEPT EXPLORATION
DEMONSTRATION & VALIDATION
FULL SCALE DEVELOPMENT
PRODUCTION & DEPLOYMENT
MI
OSD CONCEPT SELECTION
MII
OSD PROGRAM GO-AHEAD
MIIIA
PRODUCTION DECISION
(LRIP)
MIIIB
PRODUCTION DECISION
DT&E
OT&E
OT&E PLANNING OVERSIGHT
FIRST TEMP REQUIRED
TEMP APPROVAL
TEST PLAN APPROVAL
OTA/OT&E TEST EXECUTION/REPORTING
OBSERVATION/STATUS REPORTING
BEYOND LRIP REPORT

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briefings will serve to help my office fully evaluate the adequacy of OT&E plans and assess the results of early OT.

My intent in laying special emphasis on early involvement of the OT&E community is to benefit--not hinder or disrupt--engineering development. It is my firm conviction that such involvement can go a long way toward avoiding future "DIVAD experiences." Along with continuous developmental-test community involvement, it will be a significant aid in identifying potential operational effectiveness and suitability pitfalls for correction long before they become insurmountable. This in turn can prevent expenditures of billions of dollars and years of effort only to have a system flunk its final exam--leaving critical user requirements unfulfilled for still more years to come.

## OT Follow-Up

At the other end of the acquisition continuum, DOT&E is seeking to enhance OT follow-up after systems and equipment have been fielded. The purpose of these follow-ups is twofold. First, they will give us the basis for charting ways to improve the process of correcting OT-identified deficiencies during production and after delivery to the user. Second, by learning what deficiencies users have discovered in their "real world" experience with fielded systems and equipment, we can improve the way we do OT.

## DOT&E Program Oversight

Title 10, Section 136a, U.S. Code requires DOT&E oversight of all major defense acquisition programs, as defined in Section 136a(a)(2)(B) and Section 139a(a)(1). Currently, there are more than 110 such programs. With the addition of non-major programs, DOT&E has oversight responsibility for more than 150 acquisition programs. During FY 1985, many program oversight activities took place.

I have already covered our TEMP and OT-plan approval review activities and initiatives. In addition, site visits were conducted for the following programs:

Tomahawk Sea Launched Cruise Missile (SLCM)

DIVAD

MAVERICK

LANTIRN

M1A1 Tank

LCAC

Joint Logistics Over the Shore (JLOTS) Joint Test

Standard Missile-II (SM-II)

B-1B

AV-8B Harrier

CH-47 Helicopter refueling tests

AN/SPY-1B

AHIP

Joint Tactical Information Distribution System (JTIDS)

Including repeat visits, over 35 program-related site visits were conducted.

More than 13 other visits were made to conferences (Targets and Remotely Piloted Vehicles and the Crossbow-S Threat Simulator Review), Service independent operational test and evaluation organization (AFOTEC, COMOPTEVFOR, MCOTEA, and OTEA), and selected test centers (Aberdeen Proving Grounds, the Air Force Flight Test Center, the Army Combat Development Experiment Center, and the Eglin Air Force Base Air-to-Ground Ranges).

DOT&E was represented at more than 13 DSARC or other similar program reviews, including:

Carrier Helicopter

Navstar GPS User Equipment

F-18

High Frequency Anti-Jam System
SSN-21 Attack Submarine
Automated Message Processing Exchange
WWMCCS Information System
AMRAAM
AHIP
SUBACS
ATARS
Air Defense Aircraft

During FY 1985, three programs monitored by DOT&E--TOMAHAWK, AHIP, and DIVAD--reached the point at which a decision on proceeding beyond low-rate initial production (LRIP) was required. As we entered the current fiscal year, the Marine Corps' AV-8B Harrier program also reached the LRIP decision point. Assessments of all four programs were reported to the Secretary of Defense and the Congress. The TOMAHAWK assessment was favorable and the program is proceeding. The DIVAD assessment was unfavorable, and the Secretary of Defense terminated the program. The AHIP assessment confirmed the effectiveness and suitability of the system in one of the three roles for which it was developed. The Secretary approved production for only that role. Our AV-8B assessment was favorable. The Secretary of the Navy--to whom had been delegated beyond-LRIP decision authority for the program--approved production of the aircraft.

## FY 1987 Budget Initiatives

During the FY 1987 DoD program review (issue cycle), DOT&E successfully argued six T&E related issues: the Cruise Missile Mission Control Aircraft (CMMCA), the Global Positioning System/Time Space Positioning Instrumentation (GPS/TSPI), Weapons Systems Data Protection (WSDP), the Electromagnetic Pulse/Design Verification Test (EMP/DVT), the Air Force Electronic Warfare Evaluation Simulator (AFEWES), and RDT&E funding for the activities of our own office.

CMMCA (PE 64755F). Current DoD cruise missile T&E support capabilities are resource constrained. Depending on the sortie length and purpose, a cruise missile T&E mission may require a fleet of from 8 to 17 aircraft to provide chase, telemetry, tanker support, and positive command and control. The current cruise missile test support fleet has only a visual (daylight, clear weather) capability, which limits it to less than 30 productive missions per year. Projections indicate more than 80 cruise missile T&E missions per year will be required in FY 1987 and beyond.

After extensive study by the Air Force and DoD, it was concluded that an all-in-one (radar tracking, telemetry, missile health analysis, command and control) aircraft was the solution. The studies went so far as to consider use of AWACS (E-3A) and F-15 aircraft as an alternative. This alternative was dropped since it would require extensive aircraft modification and the use of aircraft that were too critical to operational readiness and national security.

The FY 1987 Air Force POM contained no CMMCA funding. Consequently, DOT&E supported the modification of two 707s (C-18s) already in the Air Force inventory to a CMMCA configuration. The two CMMCAs will provide sufficient additional capability to support the projected annual 80 mission workload and will provide an all-weather capability for more efficient use of test ranges, more representative routes, and decreased per-mission cost. Although this requirement had been foreseen by the Air Force over three years ago, it took the presence of DOT&E to bring enough attention to bear. Unfortunately, because of the delay, the CMMCA capability will not be available until 1989 or 1990. Nevertheless, DOT&E successfully argued that funds should be added to the Air Force budget for CMMCA.

GPS/TSPI (PE 64755F). The Air Force is the lead Service for developing GPS-based instrumentation sets and interfaces. GPS/TSPI is more cost effective (lower installation cost) and more accurate than current ground based systems and has an inherent mobile capability (satellite based) that will allow testing over more representative terrain. GPS/TSPI, like CMMCA, will provide joint Service support. The development effort was only partially funded in the Air Force POM. DOT&E successfully argued that funding should be added to the Air Force budget to complete the development program.

WSDP (PEs 65804A and 64755F). The Secretary of Defense determined that significant advantage accrued to the Soviet Union due to unprotected weapons design and test data information. The Services were directed to plan and budget for the capabilities necessary to protect weapon system data in the FY 1987 POM. The Navy prepared a plan and funded its protection activities. Although both the Army and the Air Force prepared plans, the Army only partially funded its plan and the Air Force budgeted no funds. DOT&E successfully argued that both the Army and the Air Force should reprogram internally to provide the requisite funding for their data protection plans.

EMP/DVT (PE 64711F). The B-1B is the first strategic aircraft produced with nuclear hardness (EMP) criteria included in its baseline design. The EMP test required to verify the hardness of this system design and to establish the baseline for this life-cycle hardness maintenance and surveillance program was not included in the Air Force 1987 POM submission. DOT&E argued for and the Air Force was directed to include EMP/DVT funding in the Air Force budget.

AFEWES (PE 64738F). The AFEWES is a sophisticated simulator designed to provide threat representations for evaluation of various U.S. and foreign EW systems. Because of the Air Force's continued use of the AFEWES funding line as a reprogramming source for EW technology efforts, much-needed upgrades of AFEWES capabilities have been neglected for some time. As is the case with CMMCA and GPS/TSPI, AFEWES provides joint Service support. In view of this and the clear need to improve the facility's capabilities, DOT&E argued that funding should be added to the Air Force budget for an aggressive AFEWES revitalization effort. As a result, the Air Force was directed to include such funding in its FY 1987 budget.

RDT&E Funding for DOT&E (PE 65118D). Title 10, Section 136a, U.S. Code requires DOT&E to assess the adequacy of OT&E and the operational effectiveness and suitability of weapon systems, and report these assessments to the Committees on Armed Services and Appropriations of the House and Senate before decisions may be made for weapon systems to proceed beyond LRIP. The OT&E conducted and assessed for the required report is IOT&E. The costs of IOT&E are funded from the RDT&E appropriation. DOT&E argued successfully that, in order to carry out the statutory responsibilities of the office and not be unnecessarily constrained in its initiatives to promote test realism, DOT&E expenses should be funded in RDT&E rather than the current (FY 1985 and FY 1986) O&M appropriation.

Our FY 1987 request is $11.3 million. The specifics are detailed in the accompanying charts, which include comparisons with FYs 1985, 1986, and 1988.

FY 1987 PRESIDENT'S BUDGET

APPROPRIATION 460: DIRECTOR, OPERATIONAL TEST AND EVALUATION

($ IN THOUSANDS)

DOT&E

| PROGRAM ELEMENT | FY 1985 (ACTUAL) | FY 1986 (ESTIMATE) | FY 1987 (REQUEST) | FY 1988 (ESTIMATE) |
|---|---|---|---|---|
| 65118D | 8,465* | 10,649* | 11,300 | 11,735 |

*O&M, DEFENSE AGENCIES

## FY 1987 PRESIDENT'S BUDGET
## DIRECTOR, OPERATIONAL TEST AND EVALUATION
## FUNCTIONAL SUMMARY
($ IN THOUSANDS)

DOT&E

| | FY 1985 | FY 1986 | FY 1987 | FY 1988 |
|---|---|---|---|---|
| IOT&E SUPPORT | 1,390 | 3,975 | 4,206 | 4,518 |
| JOT&E SUPPORT | 7,075 | 5,074 | 4,594 | 4,217 |
| SPECIAL PROJECTS | -- | 1,600 | 2,500 | 3,000 |
| TOTAL | 8,465 | 10,649 | 11,300 | 11,735 |

## FY 1987 PRESIDENT'S BUDGET
## DIRECTOR, OPERATIONAL TEST AND EVALUATION
## COMMODITY SUMMARY
($ IN THOUSANDS)

DOT&E

| | FY 1985 | FY 1986 | FY 1987 | FY 1988 |
|---|---|---|---|---|
| CONTRACT SUPPORT | 3,682 | 6,625 | 6,856 | 4,918 |
| (JOINT TEST) | (2,292) | (2,650) | (2,650) | (400) |
| JOT&E SUPPORT | 4,783 | 2,424 | 1,944 | 3,817 |
| SPECIAL ANALYSIS (EW) | | 590 | 1,900 | 2,100 |
| TEST CAPABILITIES | | 1,010 | 600 | 900 |
| TOTAL | 8,465 | 10,649 | 11,300 | 11,735 |

## DOT&E Staffing and Organization

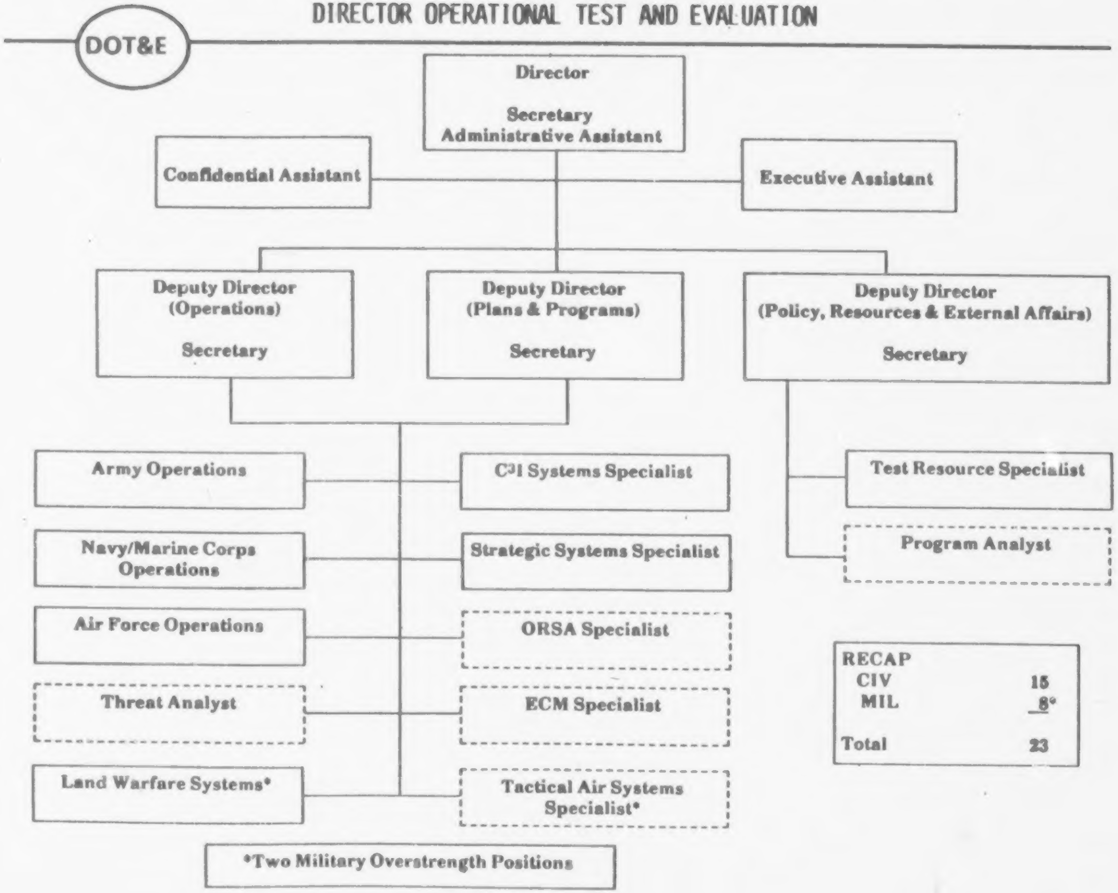
Last summer, I asked the Secretary to approve an increase in the size of the DOT&E staff. Although limited in what he could do by congressionally mandated constraints on the size of the Office of the Secretary of Defense staff organization, he authorized an increase from 16 to 23 positions (including two temporary military-overstrength positions) for my office. Nineteen positions are now filled, and I expect to have the office fully staffed by the end of March. The organization of DOT&E is depicted in the accompanying chart.

We have obtained contract technical and analytical support to assist the office in the review of plans, the analysis of test requirements, scenarios, and threats, the survey of test results, and the development of an OT data base and associated analytical tools. This technical and analytical assistance is needed in areas in which DOT&E cannot maintain the requisite expertise in house. Currently, we have support contracts with the BDM Corporation, the Institute for Defense Analyses, and Electronic Warfare Associates. Of course, my staff and I make the final judgments, which we base upon the best available data from all sources.

In addition, it is not unreasonable to think of the 12,000-plus men and women of the independent Service OT and joint-test organizations as being "staffed" to DOT&E. They develop the test plans and programs, conduct OT, and gather and evaluate the data. They report to us directly through their respective Service secretaries and chiefs, and my staff and I maintain an increasingly closer working relationship with them.

To facilitate this, and to promote cooperation among the Services, my office, the office of the USDR&E, and other DoD organizations, I have undertaken a number of initiatives. Among

# DIRECTOR OPERATIONAL TEST AND EVALUATION


DOT&E
Director
Secretary
Administrative Assistant
Confidential Assistant
Executive Assistant
Deputy Director (Operations)
Secretary
Deputy Director (Plans & Programs)
Secretary
Deputy Director (Policy, Resources & External Affairs)
Secretary
Army Operations
Navy/Marine Corps Operations
Air Force Operations
Threat Analyst
Land Warfare Systems*
C³I Systems Specialist
Strategic Systems Specialist
ORSA Specialist
ECM Specialist
Tactical Air Systems Specialist*
Test Resource Specialist
Program Analyst
RECAP
CIV 15
MIL 8*
Total 23
*Two Military Overstrength Positions

these is a continuing series of informal meetings, taking place approximately quarterly, to provide a forum for the exchange of ideas and concerns with the commanders of the Service independent OT agencies. (The most recent took place last week in Norfolk.) We have also established liaison with the test-range commanders through the Range Commanders Council, and last fall, my office hosted a meeting of Service, DoD, and contractor representatives at which the Services presented briefings on their approaches to test-resource planning. In mid-April, DOT&E and USDR&E will host a senior-level test and evaluation policy symposium to continue the process.

## Conclusion

Since taking office last spring, I have been pleased to discover in practice how generally well drawn the law is that established DOT&E. Almost without exception, the specific direction and the flexibility built into it give me both the authority and the independence I need to carry out my responsibilities. In addition, the support and unequivocal respect for the independence of this office which I have received from Secretary Weinberger and at the highest levels throughout DoD and the Services have been both gratifying and helpful.

In this connection, I cannot emphasize enough how important it is to maintain the independency of my office and our direct access to both the Secretary and the Congress. As the Congress recognized when it established DOT&E, oversight of operational test and evaluation must be conducted in an objective, rigorous, and fair manner--uninfluenced by any interest in the success or failure of the programs being assessed. It is critical that those who must make the decisions to proceed or not to proceed with major acquisitions have the benefit of the insights, advice, and counsel of an independent evaluator--unfiltered by

**any requirement to report through another official or layers of bureaucracy.**

Finally, I would like to note that we have established a good, effective, and mutually beneficial working relationship with the General Accounting Office (GAO). I know that we have learned a great deal from GAO's very professional staff, and I believe we have given them good reason to have confidence in our professionalism and judgment.

In sum, we are indeed doing the job and doing it well--and we are getting better at it with each passing day. Continuation of this sustained improvement of DOT&E's contribution to national defense will be assured so long as the strong support of Congress, the Secretary, and the operational test and evaluation community--the men and women who do the real OT job--continues as it has to date. To merit this, we must earn it. We will continue to do our best to do so.

Thank you, Mr. Chairman. I would be happy to answer any questions that you and the members of the subcommittee may have.

Mr. PRICE. Mr. Dickinson, do you have any questions?

Mr. DICKINSON. Well, Mr. Chairman, let's go back to AMRAAM.

Mr. KRINGS. Yes.

Mr. DICKINSON. This is one of the big problems we have to deal with, and one of the high priorities of the Air Force. I asked Dr. Hicks about it this morning. He says he is new on the job and cannot speak for the Secretary, even though it is his job to recommend to the Secretary, whether he would certify the system and put a cap on it or whatever.

Do you see the technical problems pretty well worked out on the AMRAAM now?

Mr. KRINGS. Yes, especially from an operational sense. I certainly support the Air Force's expression of necessity for that type of weapon, and I think it can do the job. From what we have seen in the testing, flight, and ground testing, that the weapons system will in fact accomplish what it is intended to do.

Everybody would be a lot happier if we were further along with the testing. One could make a more confident judgment or confident forecast. However, I think that some of the things that the Secretary is being asked to certify to, have to be understood, because to say that a design is complete is not possible. We have not completed design on the F-4, you know. Design is never complete. It is a living thing. I think that one can say he can agree very definitely that the basic design of the AMRAAM is complete, and we have not found anything to date that indicates that design to be wrong.

We all have to recognize that there is going to be an extensive test program and it would be one of the few such test programs ever if we didn't find something wrong and have to alter the design.

So I think the certification being required has to really be understood, that this is not an end. It is more I think in truth as you mentioned, a certification to the capability of doing the program within the dollars and time.

Mr. DICKINSON. Well, this is a two-faceted thing. First the technical capability, can it do the job. Second, can we afford it.

Mr. KRINGS. Right.

Mr. DICKINSON. It has grown so in costs that we had about concluded on this question that it just wasn't affordable. Even now I think the majority of the committee would feel that way, depending on at what level it was certificated.

I don't know if you were in the room when I was talking to Dr. Hicks, but if the Secretary might certify around 300,000 a unit, I don't think he would have any trouble with the Congress with it in that area. If it is closer to 750,000 a unit, then some people feel, they feel it probably is—then you are in a heap of hurt because it will die, I think.

Somewhere there has to be a doable figure. It is my understanding that Hughes developed this and now we are talking about Raytheon being a coproducer.

Mr. KRINGS. Yes.

Mr. DICKINSON. Raytheon has come in with a much cheaper estimate of what they can produce it than what Hughes was using. So

I don't know if it is going to be a leader/follower where the low bid gets the biggest chunk. Do you know?

Mr. KRINGS. There is a plan in which Hughes will build—I will have to be a little sketchy because I am not absolutely certain—in which Hughes will build *x* number of missiles. After that there will be a coproducing plan in which certainly the cost of the options will affect who builds the most. I think they will maintain two coproducers and there will be a competitive sort of arrangement from then on.

Again, not having the facts, but as far as the costs go, I couldn't agree with you more. The cost is turning out to be absolutely the key issue. There is no question about that. I don't think that there is a serious risk of the system not eventually working. As for how much it costs to get there and what it costs to produce them, I would be imprudent to try to give you an answer on that.

Mr. DICKINSON. Let me go to another subject then. Two years ago as I recall, we had quite a debate on the floor and then in conference on the Asat. We finally came up with a compromise figure of how many tests we would allow, and then as it turned out the Air Force wasn't able to take advantage of the number of tests that we approved.

Last year we came up with another figure and, you know, where are we in the Asat spectrum now, scheme of things now? How many more tests does the Air Force feel are needed? How capable are we going forward with the next test that would be permitted? We will be faced with this again, you know, this year, and do we need another test, really?

Mr. KRINGS. No. 1, if we are going to progress with the program as it was originally planned, I think it is absolutely necessary that we do more testing.

Again, under the premise we would go with the program the way it was originally planned, I think we need to do more testing. There was deliberation early on, the number of tests with respect to some of the lower altitude tests that may not be achievable, but that is the least area of risk and concern.

I think at this particular point in time the Air Force is ready to proceed with the rest of the tests. I am sure that if the ban on testing were removed, they would be capable of resumption of testing in a very short period of time. I don't think that there is any impediment on the side of the Air Force, except with the survivability right now or how long the target that they put up is still available to use as a target. That would, I think, be the only limiting factor in resumption of testing.

Mr. DICKINSON. When we talk about testing we are talking—there could be any number of things. You and I are talking about against an object in space, right?

Mr. KRINGS. Right, yes, sir.

Mr. DICKINSON. Not against a point in space or even a static test.

Mr. KRINGS. That is right.

Mr. DICKINSON. Bring us up to date on the HARM Program and I would yield the floor to someone else.

Mr. KRINGS. I am going to look a little bit so I am a little more correct on it.

Mr. DICKINSON. Tell you what, I would rather go to the Hellfire.

Mr. KRINGS. All right.

Mr. DICKINSON. If you go to Hellfire, are we developing a—are we trying to develop a capability so that the target does not have to be continuously maintained so you can fire and forget it?

Mr. KRINGS. Yes.

Mr. DICKINSON. Where do we stand with it?

Mr. KRINGS. It is in a development stage. Quite truthfully, this is a cop out. Since we have 23 people we are not really busying ourselves with those items still in early development.

Mr. DICKINSON. We can lend you all the help you need on the staff.

Mr. KRINGS. It is truly a fact that we are trying to focus on those things for which we are either planning an operational test as we are in one or in an assessment of one. I can find out those things for you, but truthfully I don't know.

Mr. DICKINSON. This is far enough down the road, so you haven't focused on it yet.

Mr. KRINGS. That is correct.

Mr. DICKINSON. Thank you. You have only been at it 14 years, so there is no rush.

I yield back, Mr. Chairman.

Mr. PRICE. Mr. Badham.

Mr. BADHAM. Thank you, Mr. Chairman.

When you say you have no rules and no excuses and no history, how do you decide what to test? Do you decide that or does somebody tell you?

Mr. KRINGS. There are three ways a particular program can come under our observation. If it is a major acquisition program, has achieved a certain number in R&D or certain number in total acquisition, it becomes a major acquisition program automatically.

Mr. BADHAM. Do you have a dollar figure?

Mr. KRINGS. Yes; it is $250 million R&D or $1 billion production.

Mr. BADHAM. The system.

Mr. KRINGS. Yes; it automatically becomes a major acquisition program. It comes under a lot of rules and regulations, one of which is that we gain oversight for that particular program and report on it both annually when it is in testing and at the end of the program prior to making a decision to go into full rate production.

Mr. BADHAM. To whom?

Mr. KRINGS. We do——

Mr. BADHAM. Do you have two bosses?

Mr. KRINGS. Yes, sir, we make a report to the Secretary and to the Congress, the same report.

There are two other ways that a program can come under our observation or oversight. If the Secretary of Defense unilaterally decides that that program should be monitored by us, then it becomes monitored by us, but only for operational test and evaluation. It doesn't have to undergo all the other scrutiny that it would if it were a major acquisition program. It is a case one in which he has decided that he is interested in the operational effectiveness but doesn't necessarily require us to go through all the other rigors of a major acquisition program.

The third way is that I have the authority to designate a program to be under our oversight. It follows the same rules as one that the Secretary of Defense designates. Again, we have oversight over operational test and evaluation; we have the reporting requirement, but it doesn't have to jump through the rest of the hoops.

Mr. **Badham**. When you test a system, do you—I believe I heard you say when you were testing AMRAAM you didn't really concern yourselves as much about the cost as whether it some day would do what it is supposed to be able to do.

Mr. **Krings**. What you are driving at is absolutely true. However, in my other role as being a principal member on the Secretary's staff I can use my operational knowledge to help make judgments on cost and other things. I don't have to limit myself strictly to that narrow view of life.

In AMRAAM specifically, there hasn't really been any significant operational testing in which I would be involved in making a real credible hindcast as to what AMRAAM is doing. It's more of a forecast and putting in my 2 cents like everybody else on the staff, helping the Secretary make a judgment as to whether he should in this particular case sign the certification or not.

So I am involved but not with strictly that hat on.

Mr. **Badham**. But with any hat you choose to wear on any given day you can, using your words not mine, you can employ the well and often used cop out saying sorry, I didn't test it.

Mr. **Krings**. If I didn't test it I would not be able to give any advice that would be firsthand as a result of the test, meaning hindcasting. But, certainly, I would be expected to forecast if somebody needed it, and I am the only forecaster there.

Mr. **Badham**. Then when you do test the system who makes up the criteria?

Mr. **Krings**. The Service makes the initial criteria based on the requirement. That is, the discipline we are trying to inject with the test and evaluation master plan. So when the system is originally conceived and the concept is accepted and we go into validation, at that time the Service should have a balance between the requirement and what the criteria for acceptance—or pass-fail, if you will, on the final exam—because it is the one who is getting it.

Mr. **Badham**. When you come to the final exam, your advice goes to the Congress and to the Secretary?

Mr. **Krings**. Yes, sir.

Mr. **Badham**. Do you include such things in there as, well, I don't like this system and you don't have anything to replace it and it will cost so much and whether or not this system in question could be fixed or not?

Mr. **Krings**. When the Secretary makes his decision—and I assume this is true from my recent exposure—he will take our operational view of life and then look at others to balance that against costs, alternatives, replacements, et cetera. If that "operational test hat" goes off and there is a discussion, I feel free to make an expression, if asked, on the whole balance between cost, replacement, and the like.

However, officially in my capacity of Director of Operational Test and Evaluation, that report would narrow itself to the effectiveness and suitability of that weapon as it was tested against those criteria that had been agreed upon when the weapon system requirements were written in the first place.

Mr. **Badham**. You have given your opinion on AMRAAM?

Mr. **Krings**. Yes, sir.

Mr. **Badham**. But you haven't tested it?

Mr. **Krings**. That is correct.

Mr. **Badham**. Thank you, Mr. Chairman.

Mr. **Price**. Mr. McCurdy.

Mr. **McCurdy**. Thank you, Mr. Chairman.

Mr. Krings, I think that my colleague, Mr. Hertel, is probably going to delve into specifics on the adequacy or sufficiency of your staff to carry out your functions, but I was curious as to whether or not the fifteen professional and eight administrative positions are sufficient to perform what you consider your mission to be, and if you were dealing in an optimal situation, what kind of resources and talent would you request or like to have to perform that job?

Mr. **Krings**. When we first started we obviously were given *x* number of people. We petitioned for more people. The OSD cap basically didn't give us room for more, but gave us half of that. Though we needed 40, they said that sounds like too much of a step, 16 to 40 shouldn't happen overnight, so I said 30. We petitioned for 30 and we got 23. The OSD cap is a fact of life. I understand that, and I think we got our fair share on that particular goround.

One must recognize that we were still learning and we were still developing since we were organized and created to do this, we are organizing and developing and finding ways to do things. One of the things we find is that there are significant numbers of programs that are going through this operational/development testing, over a longer period of time as opposed to a specific operational test that is bounded and occurs late in the life of the program.

By definition, this requires more observation because the test doesn't occur from the 1st to the 15th of April, it recurs every other Wednesday, maybe. So that is beginning to drive us to the need for perhaps more people in order to really observe and be onsite to get an insight into what is going on. That is developing into an additional requirement for people that we have not had.

Mr. **McCurdy**. I understand that, but if you had an optimal situation without a cap, what do you think is a number which you would require to do your job?

Mr. **Krings**. At this point in time—again I must——

Mr. **McCurdy**. Based on the schedule of R&D and development that we have been working with over the past few years and what we foresee in the future with SDI and all these other things coming on, what do you need to adequately test, observe and test over that period of time in order to make your best professional judgment on these systems, what would your optimal number be?

Mr. **Krings**. Right now I would go to 40 people.

Mr. **McCurdy**. Professionals or total?

Mr. **Krings**. I would say 40 total at this point in time. Now, this does not include SDI and things in the future. I think operational testing of SDI and even the approval for the planning of that will come well enough in the future that we could build up once we see how we will really do that, because we are learning how to do that, too.

Mr. McCurdy. Tell me about your professionals. What—if the Services establish the basic criteria for the test, I guess in a contract with you, what kind of expertise do you think is required of your staff in order to make independent analysis or judgments based on the results of these tests? Are these all engineers? What are your professionals?

Mr. Krings. The balance we are starting with now seems to be very good, the total number. It is a balance of both military people with operational experience who can assess whether or not the plan really does meet the operational criteria, et cetera, and can understand better what the Service is trying to do, and professionals who understand electronic warfare and technical areas, radars, et cetera, and some analytical capability.

We purchase a lot of very, very good analytical capability but we need——

Mr. McCurdy. What do you mean "purchase"? Contract?

Mr. Krings. We contract out for that. Yes; that is correct.

Mr. McCurdy. What percentage of your work is done on contract?

Mr. Krings. I would say the greater portion of the assembly and processing of data and organizing of it is done by outside professional consultant companies—IDA, BDM, people of that expertise.

Mr. McCurdy. How many items were tested this last year?

Mr. Krings. A good measure might be that we reviewed 33 TEMP's on 28 programs. The actual programs that came to fruition that were major, were about five major programs. I think in fact there were six major programs last year that came to the point at which we wrote a report to both the Congress and the Secretary of Defense.

Mr. McCurdy. It could be subsystems in addition to the systems?

Mr. Krings. They were major systems.

Mr. McCurdy. Did you test subsystems?

Mr. Krings. No.

Mr. McCurdy. Components of systems?

Mr. Krings. No.

Mr. McCurdy. So only a Bradley when it is a total package is what is tested, but not a gun that goes on the Bradley or something?

Mr. Krings. That is correct.

Mr. McCurdy. So it is only when it is a totally integrated package is it tested, it is ready for——

Mr. Krings. Very much like the user will see it; yes.

Mr. McCurdy. Let me ask you about the tests on the Aquila. What do you see as the progress relatively speaking or lack thereof with the Aquila? Where are we?

Mr. Krings. I can give you an opinion, but it has to be a cop out again because Aquila is not in operational testing. However, we have had people previewing and getting information so that if operational forecasts must be made, we are in a position to understand it a little bit, even though we cannot hindcast.

It appears as if, No. 1, Aquila is an incredibly difficult thing to accomplish—not the flying of a small airplane but the stabilization of the designation system that is an integral part of Aquila. That is a very difficult thing to do.

I am afraid that in the acquisition process the two have been married together in one, and one looks at the whole thing as if it were a little airplane, when in fact it is an incredibly difficult system being carried by a relatively simple little airplane.

Mr. McCurdy. That is right.

Mr. Krings. I am not so sure that that is necessarily the way it should have been structured. Perhaps it could have been done in two or three parts in which the parts could have been focused for their capability rather than lumped together and very easily criticized.

Mr. McCurdy. You are saying the classic example of trying to do too much with a small package is the Aquila?

Mr. Krings. Not knowing the actual capability of the system at this point in time, I would be reluctant to make that judgment. I think the high-tech part should have been developed in a high-tech atmosphere and the low-tech in a low-tech atmosphere, and ultimately put together rather than pacing the low-tech airplane with this incredibly high-tech sensor system.

Mr. McCurdy. The AOQ–131, jamming pod, is that a subsystem or a system?

Mr. Krings. That is a system. I would have to look and see where we stand on that right now.

Mr. McCurdy. I am having difficulty understanding what you mean by a system.

Mr. Krings. I may have misunderstood. AMRAAM, is, in a sense, a subsystems, but one might look at it as a weapon system in itself.

We do definitely involve ourselves with the LANTIRN's and AMRAAMS and LLGB's of the world, yes; definitely.

Mr. McCurdy. All right.

Thank you.

Mr. Price. Mr. Stump.

Mr. Stump. I have no questions, Mr. Chairman.

Mr. Price. Mr. Hertel.

Mr. Hertel. I wasn't here for the entire testimony but I did read your testimony. Can you flag some of the problems that you have for people meeting schedules on some of the weapons?

Mr. Krings. Yes, I think there is no question about the pervasiveness of success-oriented programs, no question about it. Consequently, it is easy to find programs that are behind schedule. They are not behind the real schedule, they are behind the published schedule.

So there are many that are not fitting the forecasts as a result of what should be accomplished at a given time.

The attempt that we are making in terms of the test and evaluation master plan discipline is to ensure that things don't change during the life of the program unknown to the players—that is, either the piece of equipment gets more complicated, the threat gets bigger and nobody realizes it or doesn't want to deal with it, or they cannot achieve what they are trying to do within the timespan and money available.

If you couple this with testing as you have said you were going to test—this is a testing-controlled procurement system, which it should be; you test and see whether you should go on—if those agreed to tests are held to fairly rigorously, then one ensures that the program doesn't deviate from the original plan because the test doesn't deviate from the original plan.

It is something we can get a grip on as opposed to the giant program. The testing isn't hard to get a grip on, though. So we discipline the system that way, but not to ensure they will meet their schedule.

We would certainly question a highly optimistic schedule because it is part of our requirement to ensure adequacy of the test plan. That is one method we have to do within this jurisdiction.

Mr. HERTEL. Can you discuss some of the problems you have with some of the projects not meeting their targets as anticipated?

Mr. KRINGS. That would be—yes, I mean you could practically pick a program. There aren't too many programs that are ahead of schedule. So I guess you could—whichever one you wanted to discuss we can look and see why we are behind in that particular program.

There are very few that are ahead of schedule.

Mr. HERTEL. Mr. Hicks yesterday didn't think there were any problems as far as the schedules.

I appreciate what you said about personnel. I think we will work very hard to get you more personnel.

Mr. KRINGS. I might caution if I may, no attempt has been made within the Department for us to petition for more people. So we have never been denied any people except in that one event that we went through to try to build up to 30 and we got the OSD cap business to stay at *x* number

We have been assessing this need and making sure that we have adequate justification both for the people and how we will use them, instead of getting a lot of people and trying to figure out what to do with them. We would much rather figure out what to do and get as many as we need. We are in the process of trying to determine how many we need as opposed to having been denied them.

We have never brought this up internally except within OSD and among ourselves to figure out what we need. But I don't want it to be construed that we are being denied people. We have not stepped up to how many we need.

Mr. HERTEL. I understand for the record you are not asking for them. It is just that it is one of our concerns and I appreciate what the idea for you would be.

Let me ask about the problem of moving high pay off emerging technology ideas into weapons systems faster. Can you help us as to prioritizing better in that area, too?

Mr. KRINGS. Yes. I think from our viewpoint the two most significant ingredients to test, evaluation and development are independency and concurrency. You have to remain independent or you just don't get the right answers.

Second, concurrency in my view should only be done on two occasions: You are way behind in what you need, or you haven't bought anything new in so long you are almost desperate. Then you go to a concurrent program in which you have to make commitments for production before testing is completed. It is a prudent thing to do. It is the only real answer.

The second is in the case of emerging technologies, where there may be a technological life in which something has an operational advantage—if you don't act soon it may not be necessary, it will be too late. You cannot afford to live through that period of time without a participant.

As Dr. Hicks talked about earlier, Stealth is one of those. You cannot afford not to play in the Stealth games. You don't know how long it will be. It is probably going to be there for a long time, but you have to do it quickly because it is something that has a limited life. When somebody figures out how to turn the light on, it will be painfully obvious where it is.

So those are a couple of good reasons to do highly concurrent programs. I would be very cautious of doing a highly concurrent program that is based on economics only, because we don't in my view have enough of a track record that shows how good we are at doing concurrent programs to really warrant doing this purely from a monetary standpoint.

When we learn to do it better and have more successes and a better track record, I think it will be an economically competitive way to acquire.

But at this point in time, to make decisions to buy before you have looked or flown very much, I think should only be done when it is necessary as opposed to something that looks easier. Many concurrent programs are advertised by people who have never done a concurrent program.

Mr. HERTEL. Well, your statement about moving ahead with certain technologies because we must and because they are ripe, do you think we could have a better list and categorize them so we can break them out? I agree with your statement there are things we should be moving ahead with and in fact must. It helps us with emphasis in priorities but it would also help you, I would think.

Mr. KRINGS. I would probably help in that situation, but quite truthfully, among other capabilities and views of life Dr. Hicks really understands that business better than a lot of people around. We are very, very fortunate to have him in that particular job.

He would be the first person I would go to, to try to better understand or categorize those both in terms of potentially successful emerging technologies, and those that fall in those categories that warrant concurrency as opposed to traditional "fly before buy" acquisitions.

I think his judgment would be far better than mine, even though there may be certain areas in which everybody doesn't agree with Dr. Hicks. In that particular area, he certainly is an expert.

Mr. HERTEL. The problem many of us had with Mr. Hicks' testimony was there wasn't very much as far as priorities or what is good and what is bad. Everything was rosey. It was very hard to get answers back in that lengthy testimony in regard to what is good, what is bad, what is most important.

That is what we need assistance with, not only because of the budget situation, but because some things must be done more quickly and can be done more quickly.

**Mr. Krings.** That is right. I certainly understand there is an economic concern. We cannot do all things for all people at all times, but again I think that I would be far less capable of determining which had the highest payoff and most easily and practically achieved than he would. I am not here to defend Dr. Hicks, however, I believe that he can do that very, very well, but he has been here too short a time to accomplish all that.

**Mr. Hertel.** I can understand that. I can understand that before the committee in open session he didn't want to make those evaluations that he might in the future privately with us. I hope we have that frank discussion opportunity soon. Thank you.

**Mr. Price.** Mr. Battista.

**Mr. Battista.** Mr. Krings, in effect you are a presidential appointee and to that extent, you do not report to the Secretary of Defense with respect to your future.

**Mr. Krings.** Absolutely.

**Mr. Battista.** You can only be removed by law——

**Mr. Krings.** I can only be fired, yes.

**Mr. Battista.** For cause, not because of——

**Mr. Krings.** Not promoted—yes, yes, that is right.

**Mr. Battista.** You introduced the general. Who writes the general's efficiency report?

**Mr. Krings.** I do.

**Mr. Battista.** You do. Is he connected in any way with Air Force programs?

**Mr. Krings.** Not directly, no. He works 100 percent full time for me.

He certainly is knowledgeable about them and has certain views hopefully——

**Mr. Battista.** Does he have an input on the AMRAAM?

**Mr. Price.** What kind of a rating do you give him?

**Mr. Krings.** A good one; I have known him for a long time.

**Mr. Battista.** Does he have anything to do with the AMRAAM program or any Air Force program?

**Mr. Krings.** Absolutely. He is an AMRAAM expert.

**Mr. Battista.** You write his efficiency report. And he has something to do with Air Force programs. But he is assigned to you for 2 or 3 years.

**Mr. Krings.** Probably 2, I would assume.

**Mr. Battista.** Then he goes back to the Air Force, not the Army, right?

**Mr. Krings.** Right.

**Mr. Battista.** Isn't that a bit of a problem?

**Mr. Krings.** One would think so, wouldn't one?

**Mr. Battista.** Many more than one would think so.

**Mr. Krings.** We have a historical event, the last one got promoted and got one of the best jobs in the Air Force.

**Mr. Battista.** He supported AMRAAM?

**Mr. Krings.** Truthfully, it is difficult, no question about it. And the people who are assigned to us, both generals and other officers, recognize this sensitivity and quite truthfully, they do a very, very good job.

It is very obvious when they are being pressured. I don't mean that anybody here right now is being pressured, but they have been, they will be, and it is only a natural event.

But we do try to recognize that, and quite truthfully, most of the Services have backed off dramatically. They realize that that could be the worst thing they could possibly do. So it is a negative feedback thing: if they do pressure and try to apply pressure through or to a member in their Service, they may end up with a more rigorous view of their approach than they would have had otherwise.

Mr. **Battista**. That is provided the problem surfaces to begin with.

Mr. **Krings**. That is right.

Mr. **Battista**. You might check with Mr. Seymour, for example, about a situation years ago when in fact the Under Secretary of Defense was advised that he had better support a particular missile program or else.

Mr. **Krings**. There is absolutely no way I will be influenced like that. I didn't come here to do that.

Mr. **Hertel**. I wanted to touch on that. You say how pleased you are with the law and your independence in this position. I guess what Mr. Battista is talking about is, and I am interested in, is not your independence because that is established, but a way of improving the independence of the people that work with you, understanding the expertise you need and experience that you need, but we have found it a constant problem to take people and tell them they will be independent for a little while, and then have to go back and face a different perspective.

We are not talking so much about somebody being unfair or undue influence, we are talking about reality as to when they are in your Agency and later on when you are back in that branch of the service.

Mr. **Krings**. There is no question about the vigilance that has to be maintained because of this particular problem, certainly a potential and real problem.

Most of the military people who are assigned to me for various reasons are on very possibly their last tour in the service. They are O-6's, colonels and captains, who have been in the service for a reasonable period of time, and probably do ultimately end up retiring from the Pentagon. Fortunately, most of the people I have, have a relatively independent view of their relationship with their services.

They also carry with them a lot of experience and, in many cases, a lot of experience in testing and in the organization that is writing the tests within the service. So they know what goes on there. They know what doesn't go on there too. They know pretty well how to deal with it.

So this balance is quite good. If one had carte blanche, what one would like to have, obviously, is the former military person with high experience who doesn't owe them anything and really knows what is going on. It is incredibly difficult to attract and create an organization of those people within the Defense Department because they are almost mutually exclusive, because of the rules and regulations about what retired military people can do in terms of income and jobs with the Defense Department.

Now the civilian people we have, we don't have that problem with because they are mostly technical experts and they will argue the technical end of it. They are not pressured significantly by any of the services or their professionals within that service.

Mr. **Hertel**. So what you are saying is you would like to make use of the people with experience who are retired who would be totally independent for you, and it is really a financial problem with the laws as far as pensions, et cetera.

Mr. **Krings**. Yes, or former military. They don't have to be necessarily retired. They bring the expertise but don't have to go back into the camp.

Mr. **Hertel**. Do you have adequate salaries to attract those types of people if there was not otherwise a conflict? Would they be taken by private industry or going with you, with that level of experience you are talking about?

Mr. **Krings**. We have not been hampered except—and I am out of my area here—but they are not—they cannot get their retirement pay, they can only get GS ratings and things like that, and there are much more attractive opportunities because they start at a different floor when they work outside the building. So that doesn't make it very attractive, certainly.

Mr. **Battista**. Let me get back to a specific test. You cite here the DIVAD test.

Mr. **Krings**. Yes.

Mr. **Battista**. Did you review the service test plan for that?

Mr. **Krings**. Not personally. It was reviewed by the organization prior to my physically being there. We did review it in that particular case, there were a lot of reviews almost up to the time of execution of the test.

Mr. **Battista**. Let me tell you where I am coming from. The chairman asked that I give a presentation on February 5, an evaluation of the Department of Defense testing. I made a number of observations that, one, there seems to be a growing number of success-oriented tests, that quality testing is on the decline, there is more emphasis on quantity rather than quality to come up with numbers that indicate 70-percent success rate without regard to the realism of the test.

And that in fact specific tests were, reports were misrepresented to the Congress. I believe that. I can give you chapter and verse. I can take you back all the way to the days of the early 1960's but there is no point in going through that.

Let me say on DIVAD test, I would wonder why anyone in your office—I know it was before your watch—would allow the service to augment a target with four fluorescent panels to generate a doppler that doesn't exist in the real world. That is simply a waste of the taxpayers' money.

Whether or not you are for or against DIVAD is not relevant, the fact is a test like that causes erosion of public confidence. Remember in this town perceptions are reality and Washington is not Newtonian, for every action there is a corresponding overreaction. You know, when you have a test result like that there is a tendency to fault the entire program. It casts doubt on that program.

Why would a test like that—you said it was reviewed by your office before you got there. Why would a test like that even be allowed to go on?

Mr. KRINGS. If you pick out particular tests within any given set, DIVAD being an example, and specifically depending on what the weight of the outcome of the test is, you can technically—not politically or perceptively—but technically assess tests that maybe are not as rigorous as those you would do in a realistic environment.

However, if the large picture that you draw as a result of all these tests is taken into perspective and each one is weighed properly, you can still get the right answer. This does not overcome the public perception that any given test is a weak test and therefore is sympathetic of the total quality of the test. We understand that.

Mr. BATTISTA. I understand that but that is not——

Mr. KRINGS. Let me finish, it is my nickel.

Mr. BATTISTA. That is not a—that is not subject to any interpretation other than fraud. To generate something, a phenomenon that does not exist in the real world and then conclude that this system has a capability against a low flying helicopter is simply misleading, not only to the American people, more importantly the poor guy who has to go out and use that system, and thinks it is going to defend him.

You know what kind of doppler a helicopter generates. And to do a test like that I think is a disservice, not only to the program but to the entire Department of Defense.

There is another thing I have learned in this town, you can do 99 good things but as soon as you mess up once that tends to stand out in someone's mind.

I think there is a lot of extrapolation.

I contend that there are many other systems that are in equally as bad a shape as DIVAD as far as testing goes. I can name for you one major system that costs over $100 million a copy that never was tested in a particular jamming environment, and the response is, well, we know it isn't going to work. Why don't we level with the Congress and level with the guys, that is why we don't test it so these folks can make up their minds; the imaging infrared test, I would like to see the latest test.

But to have a contractor representative in the control room telling the pilot when the video looks good, the imagery looks good?

I really don't think that is fair to the guy who is going to have to go out and fly it. Do you?

Mr. KRINGS. No, that is why we are here, to prevent those things that other people allow to occur that you have just recited in the past. The test you refer to took place before my office was created. DOT&E had nothing to do with approving or assessing it. We are here to ensure that that doesn't happen any more, and I am personally responsible to ensure that it is not going to happen anymore.

Believe me, I am going to make sure it doesn't.

Mr. BATTISTA. Well, at the outset then, let's face it, you need more than 40 people right now, I mean, because I will tell you, this function was given to Russ Murray, the previous Assistant Secretary of Defense for PA&E, and if you might go back and review some of his memos on the subject when he told the Deputy Secretary Duncan, let me do the job right or take it back, because I will not be a part of this sham.

I think to maintain cognizance over 140 weapons systems with 15, 20, or 25 people you are going to be awfully hard pressed. You will have people working three shifts a day. I think it is just physically impossible. So I think at the outset we both have to admit—I think you will agree—you need more people.

Mr. KRINGS. I think you are giving my speech. I did say we do need more people. We have been assessing it for 1 year to determine how many people we need. I am just of the political persuasion that I don't want to get too many people before I know how many people I need. It is a matter of gradual assessment of the problem and the results. We are more than willing to accept what we need, and we will petition for what we need.

But we are not going to try to assess what we need before we really know it. So we are going in that direction. I can assure you with respect to credible tests and the rigorousness of tests, things are changing. If you ask the people who are participants you will find out they definitely are changing.

The one who probably notices more than you do is the Secretary of Defense, because he is finding out what is going on at the same time. He has rigorous tests and he is getting rigorous answers. As for the numbers of people, we are addressing that. We are beginning to understand what we need, and we want to make sure we have the right person in the right job and how many we need to get the job done.

So far those programs that have been reported on, I think, have been reported on fairly, I think that the outcome is a true judgment of the operational capabilities, effectiveness, and suitability of the weapon systems we have reported on that the tests we are approving are much more detailed and rigorous than those done in the past.

There are a lot of them in transition and we have not tried to change everything overnight. We are working in that direction. We hope to do it moderately and nontraumatically, but very effectively.

Mr. BATTISTA. Let me ask, on the AMRAAM, perhaps I misinterpreted what you said but you came across to me as being an advocate of the system already.

There were two issues, cost and design. I agree, a system is never really complete in terms of its design because you always make modifications to it to improve it commensurate with the threat. But the context in which the legislation was written was such that we were asking for certification of the dollars relative to the design, a completed design that basically meets the minimum specifications outlined in the old development concept papers.

Now, remember, this missile started out at $68,800 a copy and we all smiled back then. You know we should have ordered 100,000, firm fixed price. Then it grew to $75,000. I was contending $750,000 and the Air Force said absolutely wrong.

Now in 1979 it got to $429,000, and then in 1984-85 goes to $479,000, and then there was an independent ICA, cost analysis, in December 1984 that said $480,000 a copy and low and behold, now there is a certification requirement it is miraculously coming down to $300,000.

When you ask people how you do that, is that based on the current design? The answer is not really, it is based on a design change that could conceivably produce a cost reduction. Maybe you would have to go with a crossfield amplifier instead of the tube or something like that. But that is not the missile you are building.

Now, I read Dr. Hicks' statement and everyone I talked to in the Pentagon seems to be an advocate of the AMRAAM. I certainly believe we have to satisfy that requirement. But let's level with people in terms of the cost and performance and its capability.

If you read his statement he says that it is more maneuverable, it would have a greater F-pole, which is implied in there, and it has all the good things. That is not true.

You can take a tail-controlled Sparrow and it has greater F-pole, greater maneuverability, horizontal and vertical launch, in those terms. And if you look at the simulation data on AMRAAM you will find aerodynamically it is worse than the tail-controlled Sparrow.

All we are saying with AMRAAM certification is, look, you told Congress and the user you would develop this missile at this price. Now, the fact is you are off by at least a factor of 6,000 in the price, they admit to that. I think it is more like a factor of 11 or 12.

But the design criteria in that certification is intended to correlate with the development concept paper.

So you know I am kind of at a loss as to why everybody is getting on this AMRAAM bandwagon in the absence of one, knowing what it really does; two, what it really costs; and three, its comparison to other alternatives.

You may want to comment on that. I don't know. That was kind of a long litany but what it boils down to is we just want to know what we are getting and for how much.

You know, you express some confidence in the AMRAAM Program. There are five software tapes, I don't think but two have been integrated so far. The algorithms were not checked out. We were at Hughes plant with independent consultants we hired about a while ago and these will not be checked out any time this year, I don't think. I wonder why we have a high confidence, is it high confidence in the promise or high confidence based on the tests?

Mr. KRINGS. I think I did mention before that, one, my contribution to any decisionmaking on the AMRAAM is, do I think it is going to work. That is about all you can ask. Nobody knows for sure it is going to work. They have just an opinion based on what they have seen.

My view is that, yes, I believe that the AMRAAM will achieve what the operational requirement is. I cannot back that up, and I never intended to. Nor did I say I would with the testing that has already been accomplished. The testing that has been accomplished doesn't indicate it won't work, so it is not unreasonable to assume based on what has worked so far, and what has been planned and history and what they are trying to accomplish, that it will work.

I am not in any way, shape or form trying to predict how long it will take or how many dollars it is going to take. I could do that, but I have not even attempted to do that. There are others who are infinitely more qualified than I to make that judgment.

I don't think it is a bandwagon. I think it is a requirement that can be satisfied but somebody else has to decide the value and the worth and practicability and affordability. I am only talking about what we have seen, what seems to be the potential and forecast for operational capability.

Mr. BATTISTA. Are you going to take over the function of joint live fire tests?

Mr. KRINGS. I don't know whether I am or not. We have been discussing it. There are a number of operational test activities that still reside within USDRE that were inappropriate to transfer when we first started our organization—having only 16 people didn't lend itself to taking on more work than we absolutely needed. At this point in time we have been discussing with Dr. Hicks and Dr. Navarro certain operational testing activities that are still solely under the control of USDRE that could conceivably be transferred or shared, depending on the percentage of operational test activity in that particular area.

Live-fire testing is one. We feel that live-fire testing is a step toward operational testing, but may not in and of itself be operational testing since it is only vulnerability testing. Obviously, you have to find out if you can shoot it before you can determine whether it is going to die.

So this is a determination of, if you shoot it, what the effectiveness is. The other answer is, how will it be employed and what will be the opportunity to shoot at a Bradley which is truly operational?

Mr. BATTISTA. There has been a terrible misrepresentation of what we were doing a couple weeks ago on the Bradley. That was not a Bradley hearing. That was used as a case in point of how not to develop a system that is to stay in development 17 years and constantly change its mission.

When you talk about joint live-fire tests in the context I mean, I mean applying it to Navy ships as well. Do you remember what happened in the Gulf of Tonkin with the U.S.S. *Warden*. There are many ways, inexpensive ways we can enhance the survivability of our ships.

Mr. KRINGS. But it is an ingredient in an operational test to determine if in fact you do shoot at something what happens to it. The other ingredient is if you can shoot at it. So it is a buildup in my view to an operational test.

Mr. BATTISTA. You don't have to shoot at the ship. You can shoot for example, at the armor that protects the superstructure with electronics behind it and determine what effect it would have. You could protect your wave guides, you can do a number of things that would prevent you from being dead in the water from a cheap kill. Or a cheap piece of ammunition or ordnance.

That is kind of what we are after.

On the AHIP, that was a program that started out with 720 helicopters for $1.1 billion, then it went down to 568 helicopters for about $3 billion. Your testing as I read your report indicates it is only capable of performing one of its three missions.

Mr. KRINGS. That is correct.

Mr. Battista. Are we going to buy more of these before the tests are completed or are we curtailing production right now.

Mr. Krings. We are limiting production to those helicopters that are configured and used solely for the role that was successful. The Army, along with our organization, is preparing a very robust test to retest the other two roles. It is some people's view, I being one of them, that the AHIP in the two unsuccessful roles may have been significantly influenced by the employment techniques--tactics—and the way the people who were operating it were trained, which is a vital part of operational testing.

It was our belief, along with the Army, that these tests should be redone and redone more properly, actually more vigorously, but with proper people using proper tactics, in order to determine whether or not the new helicopter has in fact achieved the operational criteria that are necessary.

That is in the process of being done, but acquisition is limited in the meantime to the single passing role.

Mr. Battista. When you say acquisition is limited to the single passing role, we are still going ahead and buying products.

Mr. Krings. Yes.

Mr. Battista. That means we will have an expensive helicopter for a single mission if things don't materialize.

Mr. Krings. This is the way I understand it—and, again, the procurement schedule we are certainly knowledgeable of but it is not our vital interest area—We found in this particular case there was not a significant additional cost, if any, to acquire the helicopters for that particular role.

But the full acquisition program will not be embarked on until the subsequent testing is done to ensure that the other two roles are satisfactory. So this was an economic judgment as well as a technical judgment.

Mr. Battista. You said something earlier with respect to your total, you said in some services that is viewed as lower half, Assistant Secretary lower half. Would it be more helpful to you if Congress amended the legislation to name you as an Under or Assistant Secretary of Defense, since perceptions are so important?

Mr. Krings. DOD is a very perception-oriented organization, as you well know. In all truthfulness, we get our job done because we have the big hammer at the end, but getting my title changed would probably help a lot of people that work for me. They are equally downgraded in their relative perceived position in the system.

You know how that works. So, consequently, I think that in many cases we spend an incredible amount of time explaining where we are and what we do as opposed to how we are named. It is not a very big thing for me personally, because most of the people I deal with we are not dealing with ranks. But a lot of other people are. The services certainly look at that, too.

So I guess I would say that it would definitely be helpful. It is not an urgent necessity, but it would be very helpful.

Mr. Battista. You said you are enjoying the cooperation of Secretary Weinberger. Assuming the Secretary may leave next year or 2 years, yours is a 6-year term? Perhaps you might not get a Secretary who would be as cooperative with you in the future. Yet even though the legislation has been established, the implementation of that legislation is important.

So if the Secretary didn't exactly appreciate your efforts he could constrain your dollars. What I would be asking is, wouldn't it be better for you if all major systems had to subsidize you, that is, included you in their budget to accommodate your funding needs for testing? So that there would always be that fixed amount of money, the required amount by statute as opposed to like now.

Mr. **KRINGS**. This is where my lack of experience in this area comes in. We have had no problems getting the funding we need, and the support at higher levels in the Defense Department has been very, very high, both the Secretaries of the services as well as the Secretary of Defense.

They truly do agree and recognize the way the law was written. They are really not going to go into production without us writing you all, the Congress, a statement on how well a system works and that it does work.

To project what might happen, I would be the least capable of projecting that, probably having the least experience around here to do that. I don't really even know whether that would be a benefit. I honestly don't.

Mr. **BATTISTA**. It would guarantee your funding.

Mr. **KRINGS**. Yes; I don't know what other implications of the money availability and different colors and so on are. I would assess that and try to give you an answer as to whether that would be desirable, but it would be wrong for me to make that kind of a personal judgment. I don't know enough about funding.

Mr. **HERTEL**. Several of us are working on strengthening your independence and strengthening your abilities, and we will be talking about that with you. Your testimony has been very helpful in the discussion of having more personnel in the future, and our discussion of having more ability to have independent personnel in the future, and your indication that an upgrade in your position would be helpful to the people working with you in many ways.

We will be discussing other ideas with you at a later point.

Mr. **KRINGS**. When you asked originally about alterations, there is one that would help. The way the law was written, it is rather narrow in that it talks about field tests, and then it has some language basically about combat systems.

The T-46's and F-45's are not combat systems, but they warrant operational testing because they are trainers. If I might suggest anything that may be of immediate value without any study, it would be to alter the definition so that it did in fact include what we do—which is sometimes operational testing with simulation before anything is ever fielded, and also testing of systems that are not necessarily combat systems.

We operate properly, but the law does not cover all of what we do. We were ready to change a few DOD regulations along with USDRE to put out some new test and evaluation regulations, and we were going to take the liberty of doing that. It was agreed upon by all participants, but we wanted to follow the law instead of making our own. So this would be one particular item of legislation that would be helpful, to include what we really do.

Mr. **HERTEL**. We will follow up on that.

Mr. BATTISTA. On the AMRAAM, could you coordinate with Gerry Schieffer at the Naval Weapons Center and discuss some simulation results that they had.

Mr. KRINGS. I am very, very familiar with Sparrows and AMRAAMS and——

Mr. BATTISTA. No, I am talking about the aerodynamic performance in the AMRAAM demonstration. He is on the AMRAAM panel. I would appreciate it if you could get with him and discuss the aerodynamic characteristics of the AMRAAM.

Mr. KRINGS. Some of our people have recently made a trip out there to talk to them about that. We didn't go into the details, but we have been with them and we will get back with them.

Mr. BATTISTA. Thank you.

Mr. HERTEL. Thank you very much for your testimony.

Mr. KRINGS. Thank you.

Mr. HERTEL [presiding]. We will call up Dr. Duncan right now. We would like to welcome you for your first appearance before this subcommittee. It is rewarding to this committee to have all the major research and development billets now filled within the Department of Defense.

Dr. Duncan, your Agency's major task is to provide the technology needed to make the major breakthroughs that will allow for offsets in the quantitative advantage enjoyed by our adversaries. I am particularly interested in hearing about your efforts as you transition emerging technologies into the Army, Navy and Air Force.

We keep hearing about all these innovative technologies that could be developed, but we see few materializing in actual weapons systems. I know you are not primarily at fault or totally responsible for seeing that these technologies are transferred to the services, but we are interested in your thoughts on how to improve this process.

## STATEMENT OF ROBERT C. DUNCAN, DIRECTOR, DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

Mr. DUNCAN. Thank you, Mr. Chairman.

I have just assumed the position of Director of DARPA, Mr. Chairman, and members of the committee, so this is my first appearance before the committee as you well know. I have found, in my first couple months at DARPA, a lot of exciting things going on and I would like to transfer to you some of the excitement and innovations I see in DARPA.

My staff recommends to me that I take 30 seconds and tell you about myself, but I think that that would be the least interesting subject I could do unless the chairman requests it.

Mr. HERTEL. I have your biography.

Mr. DUNCAN. You got that, OK.

Mr. HERTEL. Maybe you have something more interesting to tell us. It is an excellent biography.

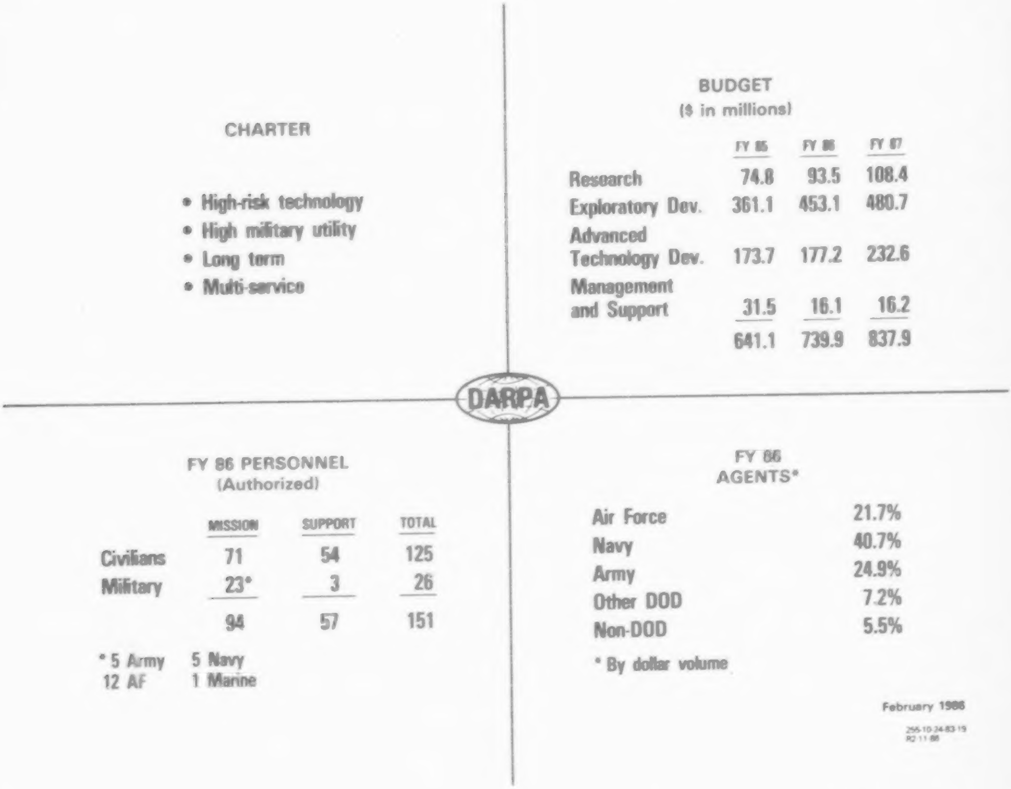
Mr. DUNCAN. Thank you.

DARPA is one of the few government research organizations chartered to do long-term research activity in high risk technology areas. In my judgment, it performs similar to a corporate research laboratory in private industry. In those laboratories we select programs on the basis of their promise and they don't all fulfill that promise. In the case of DARPA we select programs because of their potentially great military utility and programs where it is not clear just which military department they should have a connection with.

I would like to address your particular issue of transition of these programs into the services at some point in time during the course of this hearing. I do have a prepared written statement that I would like to enter into the record.

Mr. HERTEL. Fine, without objection that will be accepted in its entirety.

Mr. DUNCAN. I hope you can see the slides up here.



CHARTER

- High-risk technology
- High military utility
- Long term
- Multi-service

BUDGET
($ in millions)

| | FY 85 | FY 86 | FY 87 |
|---|---|---|---|
| Research | 74.8 | 93.5 | 108.4 |
| Exploratory Dev. | 361.1 | 453.1 | 480.7 |
| Advanced Technology Dev. | 173.7 | 177.2 | 232.6 |
| Management and Support | 31.5 | 16.1 | 16.2 |
| | 641.1 | 739.9 | 837.9 |

DARPA

FY 86 PERSONNEL
(Authorized)

| | MISSION | SUPPORT | TOTAL |
|---|---|---|---|
| Civilians | 71 | 54 | 125 |
| Military | 23* | 3 | 26 |
| | 94 | 57 | 151 |

* 5 Army 5 Navy
12 AF 1 Marine

FY 86
AGENTS*

| | |
|---|---|
| Air Force | 21.7% |
| Navy | 40.7% |
| Army | 24.9% |
| Other DOD | 7.2% |
| Non-DOD | 5.5% |

* By dollar volume

February 1986

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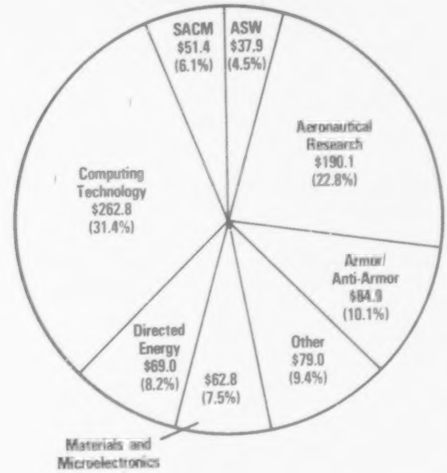
This slide indicates that for 1987 our budget request is approximately $108 million for research, $481 million for exploratory development, $233 million for advanced technology, and approximately $16 million for management and support, a total of $838 million.

We have no contracting office. DARPA contracting is done through the military departments largely as indicated in the right-hand part of the slide. Five percent approximately of the contracting is done outside the DOD.

The total number of people involved in DARPA is 151. Twenty-six are military, 125 are civilian.

## DEFENSE ADVANCED RESEARCH PROJECTS AGENCY



**FY 1987 Major Thrusts**
**Budget Request — $837.9 M**
**(dollars in millions)**

The next slide shows the breakout of the programs by area. I would like to use this as an agenda for my discussion today. This shows that 31 percent of the total budget is planned for strategic computing. In aeronautical research, $190 million, or approximately 23 percent. Armor/anti-armor is 10 percent. Much of this program is classified; therefore, I will leave that subject for the classified presentations tomorrow.

SACM [Strategic Air and Cruise Missiles], approximately $51 million, or 6 percent, and integrated ASW, 4.5 percent. Directed energy activities, $69 million or 8 percent. The 7.5 percent remaining includes nuclear monitoring, university research, small business, management headquarters and support, and other research areas that may lead to new major research thrusts in the future.

The first of the areas in this pie chart represents aeronautical research. DARPA is currently involved in several very exciting aeronautical flight research programs. DARPA does component work in the areas of materials, propulsion, flight dynamics, and systems activity. A large amount of it is computational-type activities leading up to the programs.

When it becomes clear that there is a system to be built around these concepts, DARPA joins with one of the military departments and/or NASA and works toward transition of these programs into the development phase.

DARPA AERONAUTICAL PROGRAM
DARPA
X-29 ADVANCED TECHNOLOGY DEMONSTRATOR
X-WING (RSRA)
NATIONAL AEROSPACE PLANE
PILOT'S ASSOCIATE
UNMANNED AUTONOMOUS VEHICLE

This chart shows five interesting areas that highlight the aeronautical research programs.

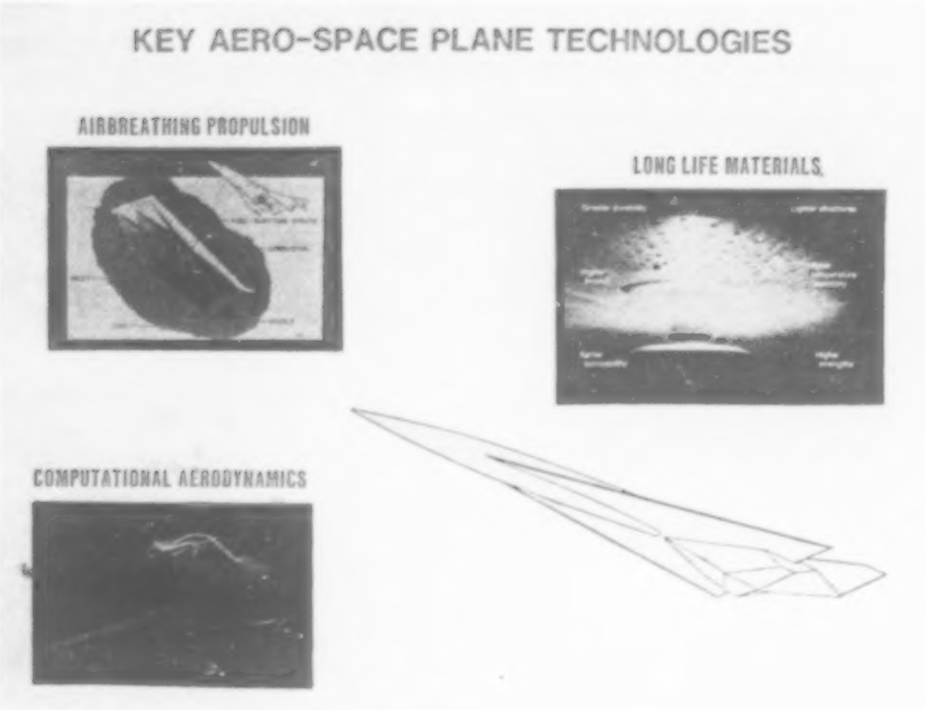
The X-29 advanced technology demonstrator, upper left. I have a model of that here. This is a forward swept wing system, probably you are quite familiar with it. It has been around a while. It has flown 34 flights so far, including some supersonic flights, and has had an extraordinarily smooth flight test program to date.

In the upper right-hand corner is the X-wing aircraft, the model is here. This represents a joint DARPA-NASA-Army-Navy program, with the first flight scheduled for this summer.

The lower right-hand corner of the chart shows unmanned autonomous vehicles. The lower left-hand corner shows the pilot's associate program. This is a program that is related to strategic computing where the computational capabilities are taken advantage of and provides the pilot with the crew, the crew is mainly a computer that has capabilities in a number of areas.

Lastly in the center is the national aerospace plane. This is a major effort and one that has captured the attention of the American public since the President referred to it in his State of the Union Address as the "Orient Express." I have the model that the President used when visiting a high school class here in Virginia to my right, and a smaller model labeled the X-30 in front of me.

This program, the aerospace plane was defined in 1982 through 1985 by DARPA with wide participation by industry, NASA and the Navy and Air Force research laboratories.



KEY AERO-SPACE PLANE TECHNOLOGIES

AIRBREATHING PROPULSION

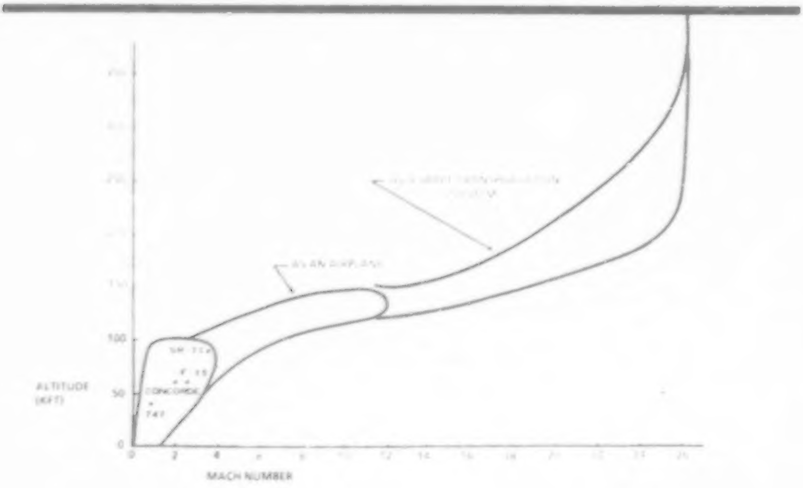
LONG LIFE MATERIALS

COMPUTATIONAL AERODYNAMICS

Recent research in the area of hypersonic air breathing propulsion, high temperature long life materials and structures, and computational aerodynamics, has contributed to a consensus that an aerospace plane may be possible.

Tests of supersonic combustion, development of high strength lightweight materials, and the availability of super computers engine/airframe integration are among the examples in recent developments.

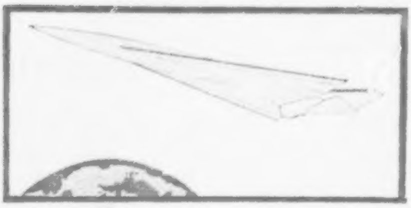
## ATMOSPHERIC FLIGHT ENVELOPES



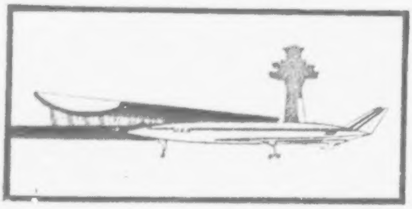
Conceptually a future aerospace plane will be able to takeoff and land like an airplane, and to cruise at hypersonic speeds up to Mach 12 in the upper atmosphere. Alternately it could operate as a space-launch vehicle capable of accelerating directly into orbit at Mach 25. It is the opinion of the technical community that this vehicle represents a revolutionary advance similar to the advance from propellor-driven to jet propelled aircraft.

## POTENTIAL APPLICATIONS OF AERO-SPACE PLANE TECHNOLOGY

SPACE LAUNCH VEHICLE



HYPERSONIC TRANSPORT



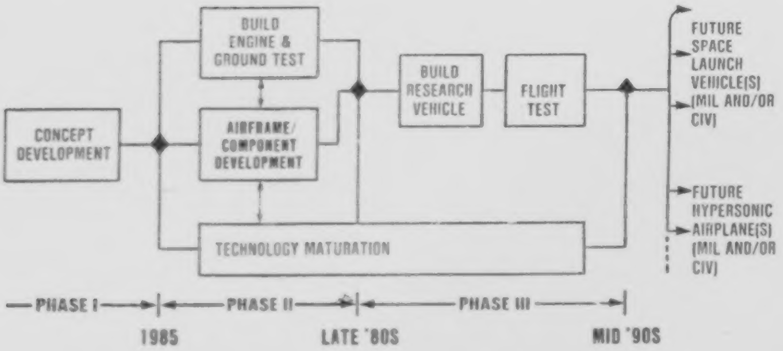
LONG RANGE INTERCEPTOR

Potential military applications of the aerospace plane shown in the next slide, are (1) extremely rapid response to anyplace on Earth, (2) a major reduction in cost to deploy payloads in space, (3) capability to operate from military airfields, and (4) significantly improved survivability.

Commercial applications include reduced space-launch costs for commercial customers, and a dramatic reduction in transit time for long-haul use.

A third area shown on this chart, for application of the technology of the aerospace plane is long-range interceptors. The Scramjet air-breathing propulsion could permit new classes of long-range, high-speed, high-altitude air defense missiles and cruise missiles.

## NATIONAL AERO-SPACE PLANE PROGRAM


CONCEPT DEVELOPMENT
BUILD ENGINE & GROUND TEST
AIRFRAME/ COMPONENT DEVELOPMENT
TECHNOLOGY MATURATION
BUILD RESEARCH VEHICLE
FLIGHT TEST
FUTURE SPACE LAUNCH VEHICLE(S) (MIL AND/OR CIV)
FUTURE HYPERSONIC AIRPLANE(S) (MIL AND/OR CIV)
PHASE I
PHASE II
PHASE III
1985
LATE '80S
MID '90S

The next chart is the block diagram of the program. Phase I, the concept development phase, was ended last calendar year, as shown on the left. Phase II, technology development is the phase we are now entering. It is a 3- or 4-year program and during this particular phase of the program, we will determine the readiness of the program to enter into a flight research vehicle development and test phase or phase III.

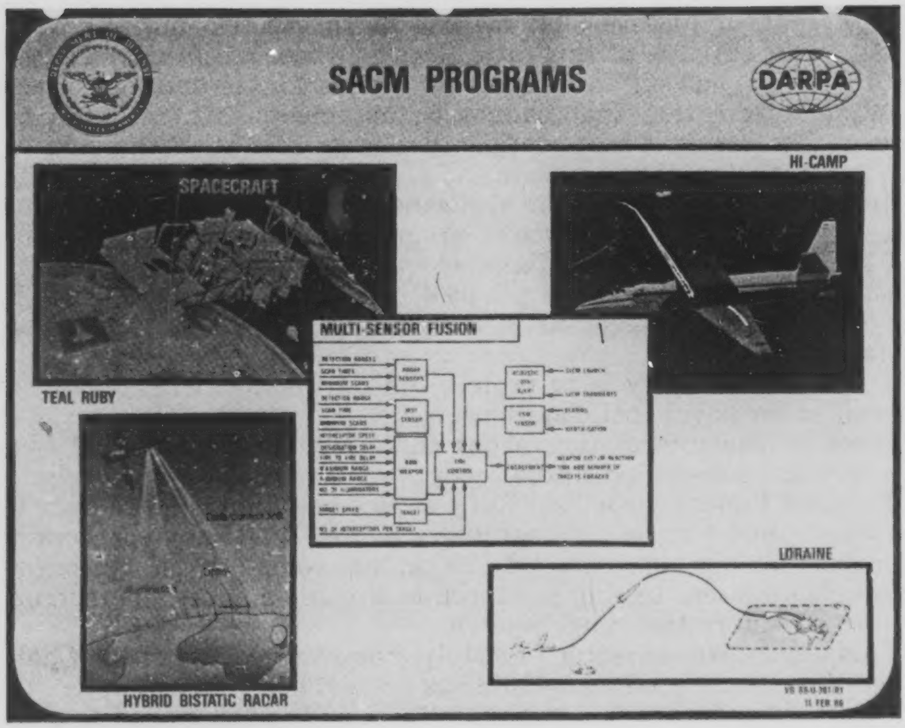
In phase II, we are concentrating on technology development and maturation, propulsion modules, airframe development and other aspects of such a system.

DARPA has the responsibility for phase II and with the transition into phase III and a flight research vehicle, we will transition this program to the Air Force. I think this is an example of the kind of transition you were talking about.

Mr. HERTEL. What money are you talking about in the different phases?

Mr. DUNCAN. The total money put in by all the partners during phase II may be upward of 600 to 700 million, of which 80 percent is DOD, and 20 percent NASA.

The fiscal year request for the overall aeronautics program, that piece of the pie chart I showed for DARPA totals $190 million.



SACM PROGRAMS

The next area I would like to discuss is that of strategic air and cruise missiles, or SACM. The objective of this program is to identify and develop techniques for surveillance of aircraft and cruise missiles. DARPA is concentrating on the "eyes" of this system—the surveillance. The program is designed to develop system concepts and associated technologies, and to provide the building blocks for advanced strategic systems.

Now, what I have tried to do is put on one chart, and it may be too busy, a kind of scope of the total program. Let me go around it. First with Hi-Camp in the upper right-hand corner. That stands for Highly Calibrated Measurements Platform. This is a test platform using a U-2 with infrared sensors to get signatures of targets of airborne vehicles. This program has been on-going since fiscal year 1981.

The lower left corner reflects the Hybrid Bistatic Radar. This is a system where the transmitter is in the spacecraft, and the receiver in a manned or unmanned air breathing vehicle. This could be of extremely great importance in the future for a low observable Soviet-types of aircraft and cruise missiles.

Loraine, stands for Long Range Intercept Experiments. It is an antiaircraft and anticruise missile concept. The major DARPA interest involves development of a radar on a missile which can survive at Mach 10 at 80,000 feet for several minutes. This will allow the development of a nonnuclear, very long-range, highly maneuverable weapons system launched from ships, land, or air, and that could kill cruise missiles.

The center of this chart shows multisensor fusion, I am sure you cannot read it; however, let me say there are two major efforts going on in DARPA in this area. This is where we bring together data from a lot of different types of sensors for the purpose of extracting information that cannot be obtained using one kind of sensor. The result is information that is greater than the sum of the parts.

Teal Ruby is represented in the upper left corner. I would like to take a little time to give you a progress report on this program.

I know this committee is familiar with Teal Ruby. It has been in existence since 1974, and the purpose is to demonstrate the feasibility of detecting strategic air vehicles using a space-based infrared mosaic sensor.

The military utility is to protect the continental United States, as well as for naval battle systems.

Much of the information about this system is classified; I can give you an unclassified status report.

The first flight article Teal Ruby sensor has completed radiometric testing and has been integrated into the Teal Ruby spacecraft. The spacecraft is approximately 99 percent compete and will begin integrated systems testing in March to support a shuttle launch on the first Western test range launch.

This launch was scheduled for July, however because of the Challenger disaster, the new schedule has not yet been determined.

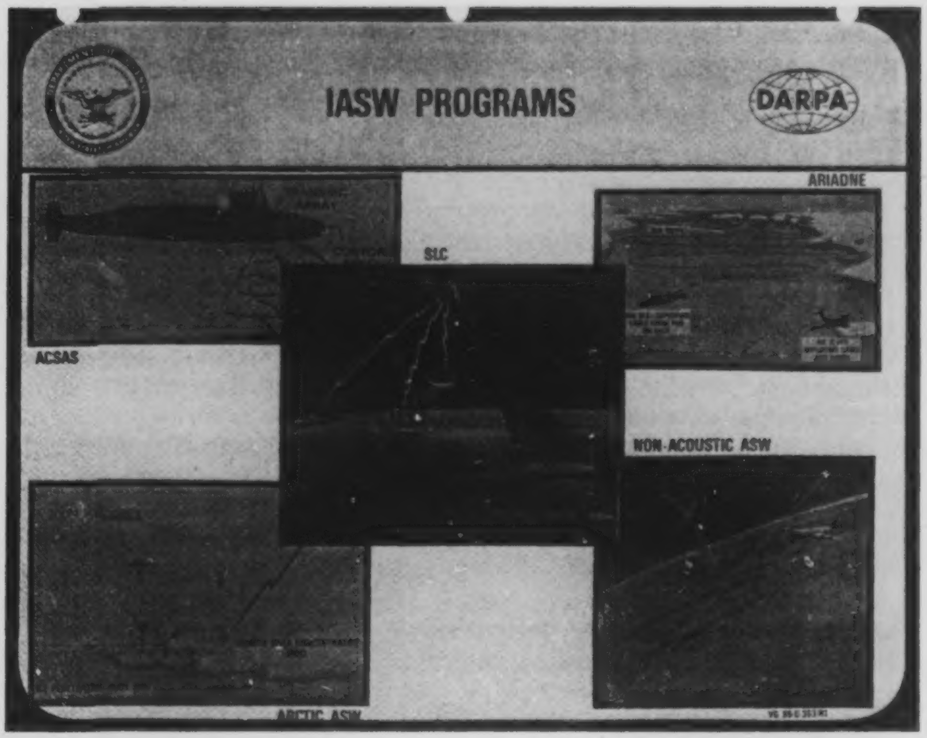
The flight software is nearly complete, and is being used to support and launch on-orbit simulation at the Air Force satellite control facility.

Final planning of the three military services, as well as three other allied countries participating, namely Canada, United Kingdom, and Australia, to provide targets for the Teal Ruby once it is in orbit—ships, aircraft, tanks, et cetera—is nearing completion.

Teal Ruby is one of the most complex programs in existence. In addition to over 110,000 parts, the software to support this is very complex. While there have been successful laboratory experiments with Teal Ruby, we are very anxious to see it in orbit and see it performs there.

This has been a joint program with the Air Force and DARPA developing the sensor, the Air Force developing the spacecraft and launch into orbit.

The total fiscal year 1987 budget for programs in DARPA in the SACM area is $51 million.



The next area I would like to talk about is ASW, or antisubmarine warfare. The goal of DARPA's integrated ASW Program is that of developing weapons systems concepts to meet an expanding Soviet threat.

We are conducting key experiments to validate critical technology elements or system concepts prior to transition to the Navy. We are currently investigating new technologies and system concepts which will significantly enhance the maintenance of an effective surveillance, tracking, localization, classification, and targeting of Soviet strategic and tactical submarine forces.

The major programs in this area in DARPA—again trying to show on one chart a feeling for the sweep of the programs, are as follows: First, in the upper right, is ARIADNE. This is a program for investigating the application of fiber optics cabling and telemetry techniques for strategic or tactical undersea surveillance. This is a joint Navy-DARPA Program aimed at developing the technologies needed to realize an expendable, deployable network. These are bottom mounted acoustic sensors for submarine detection to be deployed in forward areas.

I have here an example of a normal copper fiber cable that is used in such a system connected to hydrophones and a fiber optics cable we are using in ARIADNE. The fiber optics cable carries three times as much data as the capper fiber cable.

The next area is nonacoustic antisubmarine warfare, shown at the bottom of the chart. Here we are investigating specific sensors and integration of these sensors with conventional acoustic techniques to achieve greater overall effectivenes of inputs of a variety of different types of sensors.

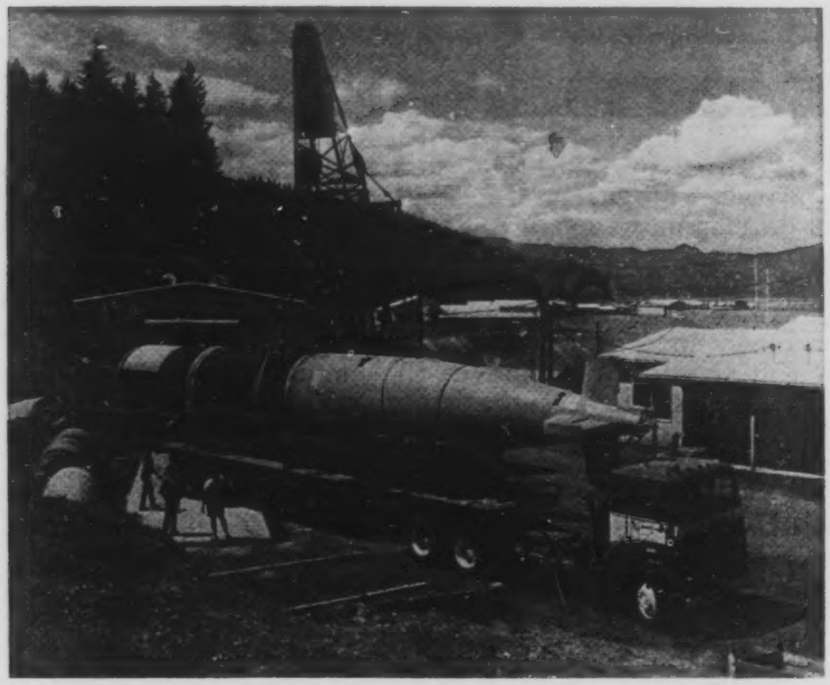
Arctic ASW, shown in the lower left corner. Obviously, an essential difference between working in the Arctic and the open ocean is the ice cover. This ice cover creates high ambient noice in the marginal ice zone and quiter conditions deep underneath the polar cap. In addition, the ice prevents the use of tactial ASW systems such as sonar buaoys and the Arctic is so far away that it is difficult to use P-3 aircraft for continuous tactical monitoring.

The submarine laser communications [SLC] satellite, shown in the middle of this chart provides transmitter and receiver technology for communicating with submarines under the water, underseas.

Reflected in the upper left of the chart is ACSAS, or Advanced Conformal Submarine Acoustic Sensor. I would like to spend a moment discussing this program.

This is a joint Navy-DARPA Program. The objective is to develop a new high gain submarine sonar to be designed as part of the ship's hull rather than a towed system which is usually used today.

This will improve the performance of attack-class submarines, and will allow a factor of 10 increases in search rate.



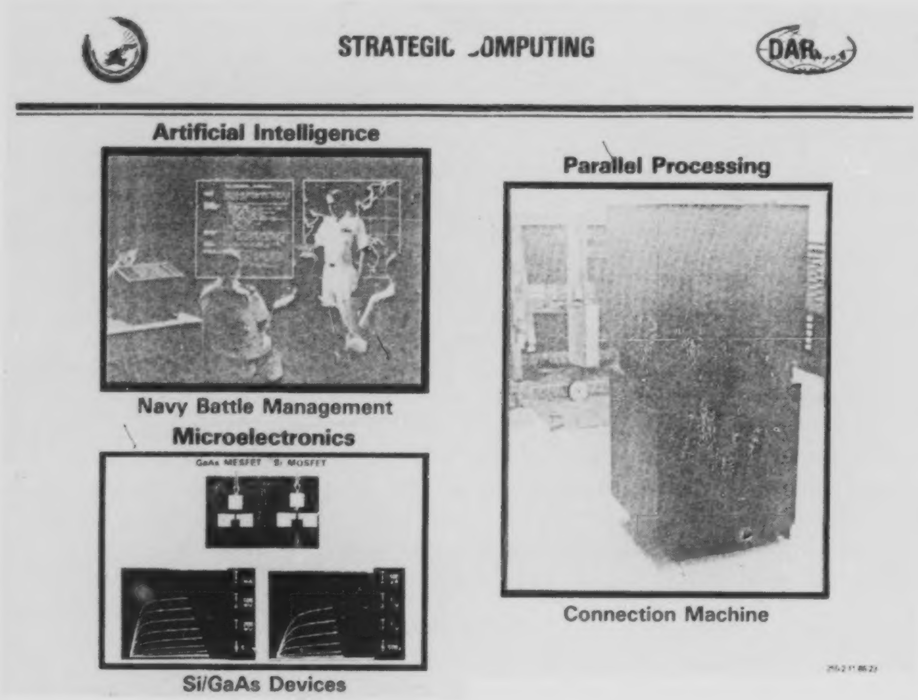
This picture shows a photograph of a quarter-scale model. Here we are talking about hardware and not ideas.

The white portion toward the nose of the submarine is the sensor array, the conformal sensor array. Conformal means it follows the shape of the hull. This is kind of an integrated Navy architecture sonar systems design. This particular vessel currently exists. It is a quarter scale model, weighs 50 tons, and it is being used to test ideas developed in the project for possible scale up to a submarine design.

This particular sonar is the most sensitive ever designed, and is capable of operating at higher speeds than ever before.

During 1986 we are scheduled to complete the scale and component demonstrations and to transition this system to advanced development. This program is currently funded jointly by DARPA and Navy.

DARPA's total funding request in this whole arena of integrated antisubmarine warfare is approximately $38 million.



STRATEGIC COMPUTING

Artificial Intelligence

Navy Battle Management

Microelectronics

Si/GaAs Devices

Parallel Processing

Connection Machine

GaAs MESFET
Si MOSFET

Next I will talk about the largest piece of pie on the chart I showed in the beginning.

Mr. HERTEL. Before you leave the submarines, can you tell us as much as you can about the blue/green development and why it is not being accelerated by the Navy?

Mr. DUNCAN. The Blue/Green program is proceeding; we are making progress. There has been an increased cost to some of the elements of the program; however, I am afraid I am not in a position to comment on why the Navy is not accelerating it.

Mr. HERTEL. That has been our problem. We know great progress has been made and we are trying to figure out why we cannot get it into operation sooner. Let me ask you, it must be very hard for you at this point to be seeing an 18-percent cut in your budget, while other things are totally protected.

Are you getting cut that much as you see the budget cutting process because SDI is being so protected under the President's budget and under Gramm-Rudman?

Mr. DUNCAN. Both DARPA and SDI are in the same budget account. The 18 percent does not result entirely from the Gramm-Rudman cuts and the fact that DARPA has to take a double share. The Gramm-Rudman amount was 9.5 percent, but including all the other cuts plus the cuts going back to fiscal year 1985 in unobligated funds, does lead us to a total of 18 to 19 percent.

I am new in the agency, having been there only a couple of months. I would almost say by act of Congress namely Gramm-Rudman, I have got involved in the budgetary process much quicker than I would like to have. Taking a cut of this size is very difficult, because the procedure that I have used in my naivete is to see what commitments we have made, that is what funds are already flowing out the door. We are already four-tenths of the way into 1986 approximately. Then looking at all the memorandums of agreement with the services and honoring those wherever they are being honored on the other side to be sure that we live up to our commitment on these, and we are doing that in every case, looking at the congressional set-asides which in DARPA's case amounted to $19 million, we assume that these are things that we must honor.

You look at the total pot that is left; what you really have discretion to make judgments on, and it gets down to the point where you do indeed have to cut programs that we consider to be so important that we hope to be able to pick it up next year and in following years.

There are programs that we don't believe should be scaled back to this sort of a level. I may have sidestepped your question a bit.

Mr. HERTEL. No. Maybe at a later time you could give us an idea before we make our final decisions which things you believe are vital that should not be delayed because they are vital.

[The statement and biography of Mr. Duncan follows:]

### BIOGRAPHICAL SKETCH OF ROBERT C. DUNCAN

Dr. Robert C. Duncan joined the Defense Advanced Research Projects Agency on November 18, 1985 as their Director; chief executive officer of an independent Defense agency responsible for research and exploratory developmental concepts that are not yet identifiable with a specific military requirement of Service mission, or which relate to the function of more than one Military Service. Provides technical direction and establishes management policy for an agency of about 145 people conducting R&D projects totalling more than $700 million per year.

Dr. Robert C. Duncan joined the Polaroid Corporation, Cambridge, Massachusetts, in 1968 and was elected a corporate officer and named Assistant Vice President in 1969. In 1975 he was elected Vice President, Engineering. From 1968 to 1975 he had the additional duty as Program Manager for the SX-70 camera and film systems.

Dr. Duncan was Assistant Director, NASA Electronics Research Center, Cambridge, Massachusetts, in 1967 and 1968. He served from 1964 to 1967 as Chief of the Guidance and Control Division at NASA's Manned Spacecraft Center, Houston, Texas. In this capacity, he was responsible for developing the guidance and control system for the Apollo spacecraft used in the lunar mission (command module and lunar module). He was Special Assistant to the Director of Defense Research and Engineering in the Office of the Secretary of Defense from 1961 to 1963. He served in 1960 and 1961 as Chief, Space Programs Branch in the Office of Chief of Naval Operations. Previously he had served operational tours in three Navy squadrons as a pilot of fighter and attack aircraft. Prior to Navy flight training in 1947, he served two years aboard the U.S.S. Bremerton (CA-130) in the Pacific and was stationed in China and Japan.

Dr. Duncan graduated with a Bachelor of Science degree from the U.S. Naval Academy in 1945. He holds a Bachelor of Science degree in aeronautical engineering from the U.S. Navy Postgraduate School, a Master of Science and a Doctor of Science degree in aeronautical engineering from the Massachusetts Institute of Technology. He is the author of one book, "Dynamics of Atmospheric Entry" (McGraw-Hill, 1962), co-author of three other books, and has published more than three dozen technical papers.

In 1964, Dr. Duncan was awarded the Legion of Merit for outstanding contributions in the field of inertial guidance and control. He was awarded the 1967 Norman P. Hays Award from the Institute of Navigation. He was awarded the NASA Exceptional Service Medal in 1968. He was elected to the National Academy of Engineering in 1981. He is a Trustee Emeritus of the Forsyth Dental Center (Boston), former Member of the Industrial and Professional Advisory Council of Penn State University, Member of the Executive Board, Norumbega Council, Boy Scouts of America, and a former Member of the Board of Directors of the Charles Stark Draper Laboratory. He was awarded the Silver Beaver (1977) and the Distinguished Eagle Scout Award (1984) by the Boy Scouts of America.

Born in Jonesville, Virginia, November 21, 1923, Dr. Duncan is married to the former Rosemary Fleming of Pensacola, Florida. They have four children: Mrs. Melissa Keeney, Mrs. Babette Wilson, Robert and Scott.

# PREPARED STATEMENT OF ROBERT C. DUNCAN

## I. Overview

The FY 1987 budget request for the Defense Advanced Research Projects Agency will support the Agency's continuing role of advancing the frontiers of science and technology in areas vital to future defense needs. Investments in breakthrough research initiated in past years are yielding a sound technology base in several technical fields for exploitation by the Military Services. This statement supporting the Agency's FY 1987 budget request, will highlight some of the important achievements of DARPA research in FY 1986 and FY 1987. It will present the FY 1987 budget request and discuss changes from FY 1986, and it will provide notable examples of technology transition to the Military Services in FY 1986 and FY 1987.

In FY 1987 and outyears, breakthroughs in materials research will be offering low cost ceramics and ceramic composites to defense applications in armor, ceramic gun barrels, gas turbine engines and radar absorbing structures. Other materials research is expected to provide options for new space structures with zero coefficient of thermal expansion and no thermal hysteresis in the temperature range of -160°F to 250°F. Research on new coating materials is expected to extend the lifetime of carbon-carbon components in high-temperature gas turbine engine applications. Electronic materials research is yielding a new permeable base transistor capable of operating at frequencies in excess of 100 gigahertz. These transistors may have the fastest switching speed of any transistor yet fabricated, on the order of a few picoseconds.

These are but a small sample of the advanced research yields at DARPA. Much of this basic and applied research base will be extended and applied in the next few years to the new DoD/NASA National Aerospace Plane program.

Other applications will be available to Military Services for armored vehicle development, anti-armor penetrators, advanced fighter aircraft, advanced cruise missiles, smart weapons, low observable vehicles, ASW, surveillance, battle management, nuclear test monitoring, tactical directed energy weapons, hypervelocity guns and many more.

The Agency's budget request for FY 1987, reflects a 8.8% real growth over the FY 1986 level. Much of this growth is attributable to the new National Aerospace Plane, and new initiatives in armor/anti-armor.

This statement will highlight some of the accomplishments and new initiatives in FY 1986 and FY 1987. It will present the breakout of the FY 1987 budget request by budget activity, discuss budget trends and program source of changes. Finally, transfers of technology to the Services in FY 1986 and FY 1987 will be presented.

## II. FY1986/FY 1987 Program/Technology Highlights

A major highlight of DARPA's FY 1986/FY1987 activities is the National Aerospace Plane technology program. This is a joint DoD/NASA research program which could lead to an entirely new family of aerospace vehicles. Conceptually, a future Aerospace Plane would be able to operate as an airplane at hypersonic velocities (4000 to 8000 miles per hour) in the upper atmosphere, or as a space launch vehicle capable of accelerating directly into orbit. The DoD/NASA program unifies hypersonic research which has been ongoing for several years. Recent research in hypersonic propulsion, advanced materials and structures, and computational fluid dynamics has contributed to a consensus that an Aerospace Plane may someday be possible. The Aerospace Plane concept was defined during 1982-1985 in a concept exploration effort by DARPA and NASA with widespread participation by industry and other government research centers. The concept centers on a hydrogen-powered aircraft capable of horizontal take-off and landing, and capable of operating at speeds between Mach 12 and Mach 25 at altitudes between 100,000 and 350,000 feet. The technology development phase, underway in 1986, will address the maturation of many technologies, propulsion module development, and airframe design of an experimental flight research vehicle. Participants in this phase include Air Force, Navy, DARPA, SDIO, and NASA. There is an 80%/20% funding split between DoD and NASA.

Potential Aerospace Plane capabilities of national interest include global flight, long-range air defense interceptor, significantly reduced payload to orbit transportation costs, and dramatically reduced transit times on long haul airplane routes with corresponding economic benefit.

The Strategic Computing project is advancing the state-of-the-art in machine intelligence, machine architectures and microelectronics. Machine intelligence efforts are underway in computer vision, speech, natural language and expert systems. A new-generation vision system demonstrated outdoor dynamic image processing 400 times faster than any previous system. A speaker independent continuous speech recognition system with a 200-word vocabulary was demonstrated for the first time. An initial version of the natural language understanding system, IRUS, is being demonstrated at CINCPACFLT. The system understands 2000 words and 700 Naval related concepts. In the multiprocessor system architecture areas, a 10-cell 100 MFlop WARP programmable systolic array system was developed, demonstrated, and is in production. A faster, more compact VLSI version is being designed. A 64 thousand processor Connection Machine has been completed and demonstrated. In fluid dynamics calculations it is a factor of four faster than a Cray-X/MP at 1/6 the cost. In document query over a 10 gigabyte database it is five times faster than a Cray X/MP and completes a search in 3 minutes that takes the large IBM mainframe currently used for this task 6 hours. In image processing, it is equivalent to 1000 to 10,000 of the VAX 11/785's currently used in many systems. This performance promises dramatic breakthroughs on many DoD imagery analysis problems. A 256 processor Butterfly Architecture has been demonstrated and performance found to scale linearly for a large number of important problems. The Butterfly processor is now in commercial production. In microelectronics, optical links for board-to-board interconnection of the 64 thousand processor Connection Machine and the WARP programmable systolic array are being investigated.

Applications of the Strategic Computing technologies are proceeding for the Autonomous Land Vehicle (ALV), the Fleet Command Center Battle Management project (FCCBMP), Airland Battle Management (ALBM), the Pilot's Associate project, and a system for Radar/Optical Imagery Analysis. In FY 1986, the Autonomous Land Vehicle demonstrated speeds up to 20 kmph over a road containing fixed obstacles. In FY 1987, it will demonstrate autonomous, cross-country, navigation over rough terrain with speeds up to 10 kilometers per hour. The real significance of these demonstrations is in showing how to integrate, in real-time, dynamic vision, expert reasoning and numerical calculations; a requirement for achieving "brilliant" weapons systems. The Naval Fleet Command Center Battle Management testbed has been installed at

CINCPACFLT headquarters and a fleet readiness evaluation aid demonstrated which provides a factor of three performance gain over unaided performance. An integrated speech/natural language interface to this aid will be installed and evaluated in FY 1987. Four demonstration expert systems have been developed in the Pilot's Associate project. These will be substantially expanded and linked together in FY 1987 and beyond. A force-on-force Corps level combat simulation was benchmarked on the Butterfly multi-processor for the ALBM project. Results show a factor of 20 to 50 improvement in execution time is possible permitting 10 hours of combat to be simulated in 4-12 minutes. Further research on ALBM will demonstrate cooperative maneuver planning between Corps and Division headquarters.

The Submarine Laser Communications project is developing the technology necessary for providing critical underwater communications using blue-green lasers. DARPA is continuing the design and fabrication of the space-qualifiable Laboratory Transmitter Module (LTM). Life testing of a laser device using the same xenon chloride, Raman-shifted technology as LTM has started. Reliability and degradation data over more than a billion pulses is being taken and applied to the LTM project. Solid state laser research for this project is underway at Lawrence Livermore National Laboratory. The LTM will be tested over 200 million pulses. Design and test data on both the LTM and the atomic resonance filter receiver will be evaluated by the Navy for possible system development and operational use.

Joint use of the charged particle beam Advanced Test Accelerator (ATA) at Lawrence Livermore National Laboratory is being made by DARPA and the Strategic Defense Initiative Organization in FY 1986. DARPA has conducted propagation experiments in full density air with remarkable results. Beam pulses which have been properly prepared have shown stable propagation in open air. The specific limits on the effectiveness of beam conditioning will be studied during the remainder of this fiscal year. The goal for FY 1987 activities is to obtain firm evidence for the feasibility of multiple pulse schemes to maximize the range and efficiency of beam propagation. It is important to note that the Advanced Test Accelerator and the entire particle beam technology base developed by DARPA will form the core of the new Free Electron Laser Program initiated by SDIO.

DARPA is accelerating its armor/anti-armor research efforts in FY 1986 and FY 1987 under strong recommendation by the Defense Science Board (DSB). The DSB findings show that the competition in armor/anti-armor now is in favor of the Soviet Union, and is continuing to increase in their favor. DARPA proposes to extend its research base in kinetic energy weapons, lightweight composite armor, platform and system integration.

There are many more elements of the DARPA advanced research programs. This report only presents those effort which have been of interest to Congress in the past, and a few exciting new initiatives.

## III. The FY 1987 Budget Request

The DARPA FY 1987 budget request is $837.9 million, a real growth of 8.8% over the FY 1986 level. The current FY 1986 budget level of $739.9 million resulted when DARPA sustained a $47.5 million allocation of the Congressional-directed undistributed Defense Agencies budget reduction. This FY 1986 budget does not reflect potential Gramm-Rudman-Hollings reductions. The breakdown of this request by Budget Activity and R&D category, along with the two prior year appropriations, is as follows:

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
RESEARCH AND DEVELOPMENT APPROPRIATIONS AND
BUDGET REQUEST ($ in thousands)

| | APPROPRIATIONS | | BUDGET REQUEST |
|---|---|---|---|
| | FY 1985 | FY 1986 | FY 1987 |
| BUDGET ACTIVITY 1 | | | |
| 6.1 Research | 74,807 | 93,480 | 108,400 |
| 6.2 Exploratory Development | 361,080 | 453,110 | 480,680 |
| BUDGET ACTIVITY 2 | | | |
| 6.2 Advanced Development | 173,692 | 177,179 | 232,600 |
| BUDGET ACTIVITY 6 | | | |
| 6.5 Defensewide Mission Support | 31,552 | 16,148 | 16,200 |
| TOTAL | 641,131 | 739,917 | 837,880 |

The proposed FY 1987 investment for research (6.1) of $108.4 million reflects a $14.9 million increase over the FY 1987 appropriations. Over $6 million of this increase is for the DARPA's University Research Initiative. DARPA's request in FY 1986 was $6.25 million and in FY 1987, $12.5 million. The Congress added $75 million to OSD to supplement the combined DARPA, Army, Navy, Air Force FY 1986 request of $25 million. The OSD is administering these funds, but DARPA expects to receive its proportionate share. A second major source of 6.1 increase is in the Electronic Sciences Project. Here, research in superlattices is being expanded. The developments of molecular beam epitaxy (MBE) and metal-organic chemical vapor deposition (MO-CVD) systems have opened up a totally novel concept for semiconductor technologies-materials engineering. Artificially created superlattices can, in principle, be tailored to yield pre-determined bandstructures selected to optimize device performance. Research in low-cost ceramics and ceramic composites, previously mentioned in Section I, also contribute to this increase. Overall, the DARPA applied research program is a major national asset, generating major research breakthroughs being exploited now and in the future for DoD, other government interests and the private sector.

The proposed 6.2 exploratory development budget request of $480.7 million reflects a $27.5 million increase over the FY 1986 appropriation. The major part of this increase is in the Tactical Technology Program Element. In this area, DARPA is exploiting a major breakthrough in devices for wideband signal processing. The research program is called Acoustic Charge Transport (ACT). It is a hybrid analog/digital device technology which makes possible small, low-cost, low power microelectronic components for large dynamic range, large processing gain, extremely wide bandwidth, radiation hard, radar and communication signal processing systems. Representative signal processing units will be designed, fabricated and tested in FY 1987. Research in the previously mentioned new armor/anti-armor initiative also contribute to the increase in Tactical Technology.

The DARPA Dual Alloy Radial Turbine (DART) research is moving into the demonstration phase. This is a gas turbine testbed of novel design (dual entry compressor, second stage compressor) which will ultimately allow testing of advanced composite materials and structures at extremely high temperatures (3500°F) and pressure ratios (25:1) in the turbine section.

Also included in the 6.2 Exploratory Development request are funds for the Nuclear Monitoring Research program. This program is providing the research base in support of the U.S. capability for monitoring nuclear test ban treaties. A prototype seismic array was installed in Norway in FY 1985 which takes advantage of seismic signals propagating along low-loss paths from the Soviet Union. An order of magnitude improvement in signal detection is expected from this advanced array for signals originating in the western part of the Soviet Union. Two advanced methods for yield estimation have been developed which are far superior in accuracy and precision to current means. DARPA is continuing its support to the Center for Seismic Studies which collects and analyzes event data from U.S. stations. Other highlights supporting the 6.2 budget request were presented in Section II.

The DARPA budget request for Advanced Development (6.3) is $232.6 million, a $55.4 million increase over the FY 1986 appropriation. The major program contributing to this increase is the National Aerospace Plane. The technology base effort is funded in Budget Activity 1 in FY 1986. Hence, the full request for FY 1987, $60 million appears, for the first time in Advanced Development (6.3) in FY 1987. The importance of this program was discussed in Section II and its priority is among the nation's highest in R&D. An additional increase in 6.3 is for a classified program.

These increases are offset, to some degree, by decreased funding in several programs undergoing transition out of DARPA. Among these are the X-29 Advanced Technology Demonstrator, the X-Wing/RSRA project, and the Teal Ruby project. The first two will be discussed in the next section.

The Teal Ruby space-based experiment will be the first large-scale implementation of a two-dimensional staring mosaic infrared detector array and lightweight telescope optics to be launched into space by the NASA shuttle. Its goal is to establish the technology for future space-based infrared surveillance systems capable of detecting aircraft and other low threshold targets against the earth's clutter background. It will develop a comprehensive radiometric background database, and space qualify the advanced technologies embodied in its design. It is expected to be under test in FY 1987.

The Defensewide Mission Support remains essentially at its FY 1986 level. This Activity supports the Agency Headquarters staff, office space and equipment, and field military procurement agents who handle DARPA's contracting.

## IV. Technology Transition

The measure of success of DARPA's investment in research and development is the eventual use of its R&D products in some form by the Military Services. Recognition of this transition of technology may not be readily apparent in many of the military hardware programs which benefit from its infusion. Research breakthroughs may occur at the idea stage where revolutionary approaches to current mission strategies lead to greatly enhanced mission performance. The use of clustered smart weapons in an anti-armor role is a typical example. The ideas may challenge the military roles and missions such that it forces a re-thinking of the battlefield strategy. Conversely, the idea may languish until elements of feasibility are demonstrated. Breakthroughs at component or subsystem level such as autonomous sensors and homing may be essential to acceptance of the revolutionary idea. A typical example of this pathway to technology transition was the DARPA Assault Breaker program. Out of this DARPA research and development demonstration was evolved the Air Force JSTARS and the Army JTACMS programs.

Another approach to technology transition may be in the form of applied research or component development breakthroughs. A typical example is DARPA's materials research program leading to rapid solidification in formation of super alloys now finding application across the Services.

A third mode of technology transition is through the university and industrial base. Much of the research support by DARPA in the universities and industrial sector finds its way into military systems when it becomes an integral part of an industrial bid on a military system. One might call this the invisible transition, as the connection to the basic DARPA supported research is usually obscured.

Some of the more prominent and viable technology transitions in FY 1986 and FY 1987 are documented here.

X-29 Advanced Technology Demonstrator: This technology is a feasibility demonstration project for advanced aerodynamics, structures and flight controls for future generation tactical aircraft. Research in advanced composite materials, computer aided design, advanced aerodynamic and structural analytical design methods, and digital flight controls is embodied in a highly instrumented experimental research aircraft which has been in flight test by DARPA, NASA, and the Air Force over the past year. Aircraft performance has exceeded predictions and the aircraft has been extremely reliable and safe. Tests were conducted by an integrated team of NASA, Air Force, and Grumman test pilots and maintenance crews. Flight test results are already being used throughout industry.

These tests are being expanded in FY 1986 and FY 1987. The FY 1987 budget request will be augmented by the Air Force and NASA to support continuation of testing and transition of the program to the Air Force in FY 1987.

X-Wing/RSRA: This project addresses technology demonstration for a vertical takeoff and landing aircraft which, by stopping the rotor in flight, combines the vertical lift efficiency of a helicopter with the speed, range, and altitude performance of a transonic fixed wing aircraft. Design analysis indicates that an operational X-Wing vehicle would have approximately three times the speed, range, and altitude performance of a conventional helicopter with equivalent payload lifting capability. These characteristics enable a very broad operational applicability such as: more flexible sea-basing for the Navy for conducting long range anti-submarine warfare; over-the-horizon targeting of surface and air targets; tactical jamming; close air support; and intra-theater self deployment capability. This demonstration project is being managed and funded in accordance with a FY 1983 DARPA/NASA agreement and utilizes the NASA Rotor System Research Aircraft (RSRA). The large (56-foot diameter) rotor, fabricated of graphite composites has been installed on the RSRA and the vehicle is being tied down for initial integration system tests. Initial flight test by the contractor will commence in mid FY 1986, and continue throughout the year. After review of flight test results and demonstration of feasibility and practicability in FY 1987, the project will be transferred to NASA for completion of experimental testing. Flights during

FY 1987 will include conversion from rotary wing to fixed wing (and reverse) with higher harmonic adaptive vibration controls.

Submarine Laser Communications: Transition of this technology to the Navy is underway in FY 1986 and is expected to be completed in FY 1987. DARPA is continuing fabrication and test of the space-qualifiable Laboratory Transmitter Module (LTM). The LTM will be tested to over 200 million pulses. An effort to explore the potential improvements to the baseline system using solid state lasers is continuing. All data from these DARPA efforts will be made available to the Navy for decision on full scale SLC development.

ARIADNE: This program, sponsored under the Naval Warfare Project of the Tactical Program Element 62702E has extended the technology of fiber optics to strategic or tactical undersea surveillance. Low-loss, wet-mateable, single-mode fiber-optic connectors have been developed and tested under 10,000 psi sea water at losses consistently less than ½ db. Lightweight, single-mode undersea, fiber-optic cables were developed and tested, and test sections are being produced in several kilometer lengths at $1.79 per meter. Repeater/Multiplexer/Connector prototypes are in final stages of fabrication. Multiple mechanical models of the successful node design, connected by fiber-optic cables, are being used to perform at-sea rehearsals of ARIADNE string deployment. In FY 1986, prototype hardware will be integrated and tested at-sea as an initial small-scale ARIADNE system. With completion of the sea tests the technology will be transferred to the Navy.

Advanced Conformal Submarine Acoustic Sonar (ACSAS): Under this program DARPA together with the Navy is conducting research on a new high gain submarine sonar to be designed as part of the ship's hull. This conformal hull array will provide two dimensional direction finding, and will allow for detection at speeds higher than achievable with current systems. Small scale array structures have been built and tested, as well as several variants of the basic hydrophone. A ½ scale system model is being fabricated and will undergo testing in FY 1987. Transfer to the Navy will be accomplished at the end of FY 1988.

AMBER: This is an unmanned low cost aerial vehicle technology development to demonstrate long endurance capabilities. The test vehicle is approximately 600 pounds gross weight and achieves its long endurance through utilization of advanced composite structures, an advanced lightweight, low-fuel-flow engine, and "sail plane-like" aerodynamics. Existing Service payloads will be integrated into AMBER along with data links and ground stations. These systems will be tested to determine the operational utility for the Navy, Marines and Army.

The Amber technology will transition to the Army and Navy in FY 1987.

Many smaller research activities are yielding spin-offs into Service applications. Some of these important contributions to the military R&D posture were discussed in Section II. Further, DARPA has several research programs which are jointly funded by DARPA and one or more of the military Services. This process leads to early technology transition.

## V. Summary

The DARPA research and development program continues to be a highly leveraged investment. In addition to the above discussed technology transitions, DARPA's research in high energy lasers, particle beam accelerators, space surveillance, hypervelocity weapons, precision acquisition and tracking, short wavelength lasers, laser damage assessment, and electromagnetic propulsion research laid the foundation for much of the research continued under the Strategic Defense Initiative Organization. DARPA accepts its charge by the Secretary of Defense to advance the frontiers of science and technology for U.S. military advantage over potential adversaries. Its efforts are devoted to searching out the bold and imaginative new research ideas and providing adequate support to foster these ideas through to realistic demonstrations of sound technology. The continued support of Congress is essential to the success of this mission.

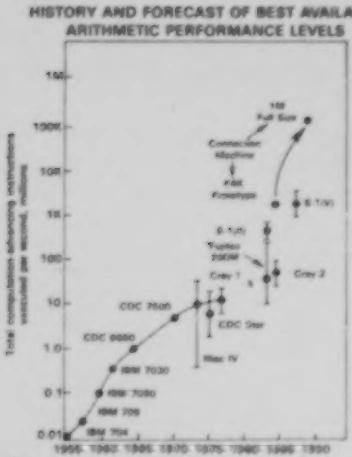
Mr. **Hertel**. I am going to recess at this time. I am very interested in hearing the next topic on the computers. Dr. DeLauer said he thought that was the best thing in this century and the next for our country. I am not sure whether there will be votes immediately following this one.

It is doubtful or undetermined whether I will be back. We see the other members are busy with conflicts. I think we will adjourn the meeting today and insert your remaining charts in the record, instead of having you wait in abeyance, and ask General Pickett to put his statement in the record, we will reschedule that and be in touch with you in the future.

I think we would like to have more members present when we talk about your next topic in your presentation, especially since it is your first appearance before the subcommittee We will get in touch with you as to the exact date.

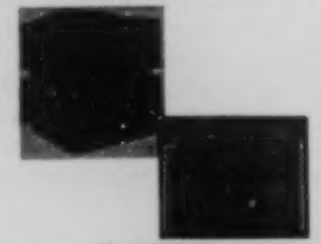
## MULTIPROCESSORS

HISTORY AND FORECAST OF BEST AVAILABLE ARITHMETIC PERFORMANCE LEVELS

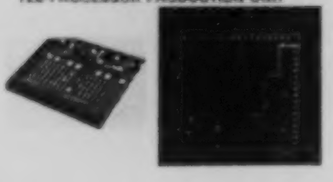


Source:
Thinking Machines Corp
Lawrence Livermore National Laboratory

TMI CONNECTION MACHINE
64,000 PROCESSOR PROTOTYPE



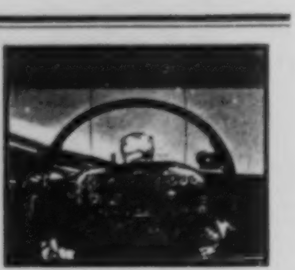
BBN BUTTERFLY
128 PROCESSOR PRODUCTION UNIT



## STRATEGIC COMPUTING APPLICATIONS

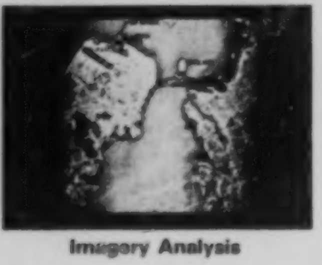
Autonomous Land Vehicle

Navy Battle Management



Pilot's Associate

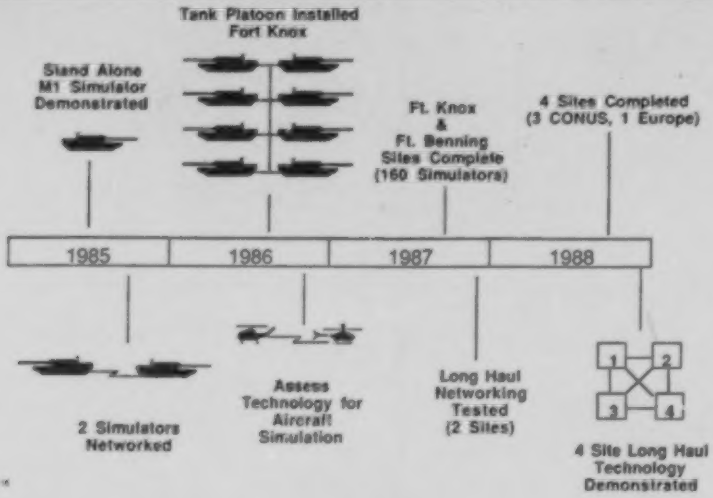
Air-Land Battle Management



Imagery Analysis

1

## SIMNET PROGRESS



Tank Platoon Installed
Fort Knox

Stand Alone
M1 Simulator
Demonstrated

Ft. Knox
&
Ft. Benning
Sites Complete
(160 Simulators)

4 Sites Completed
(3 CONUS, 1 Europe)

1985
1986
1987
1988

2 Simulators
Networked

Assess
Technology for
Aircraft
Simulation

Long Haul
Networking
Tested
(2 Sites)

4 Site Long Haul
Technology
Demonstrated

## TACTICAL APPLICATIONS OF DIRECTED ENERGY

Solid-State
Laser Technology

Particle Beam
Accelerator

Laser Bullet

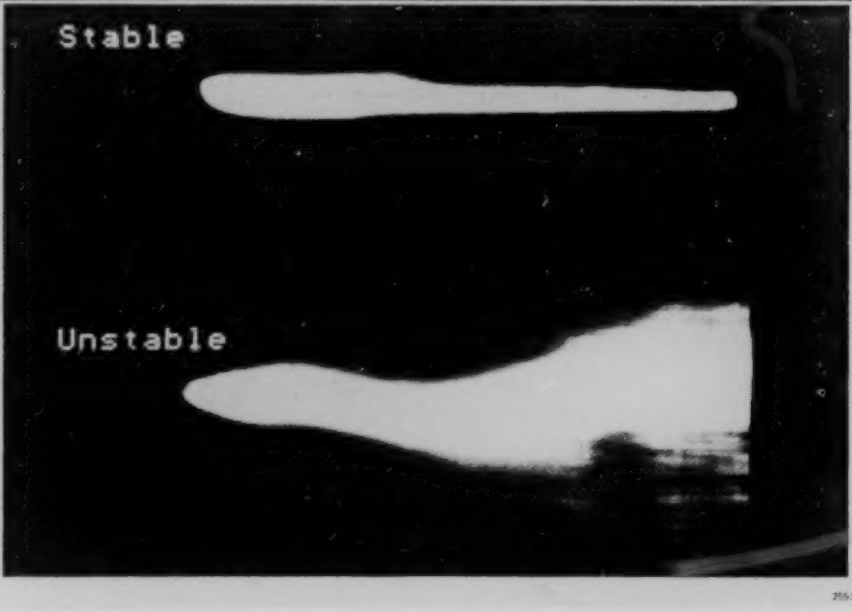
## CHARGED PARTICLE BEAM TECHNOLOGY
### (DARPA/LLNL PROGRAM)

### SCHEDULE

| | FISCAL YEAR |
|---|---|
| Start ATA design | 1979 |
| ATA completion | 1983 |
| Stable lead pulse test | 1986 |
| Open air propagation | 1986 |
| Evidence of pulse tracking | 1987 |

255 2 11 86 20

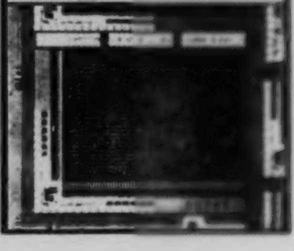
## TEST RESULTS
### ATA BEAM PROPAGATION



255 2 11 86 21

## STRATEGIC MATERIALS, PROPULSION AND DEVICE RESEARCH AND DEVELOPMENT

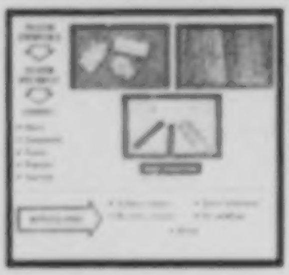
Production Quality GaAs Crystals



Low Power, Radiation Hard 4 kilobit Static Random Access Memory Chip

3D WEAVE
CARBON-CARBON
TURBINE ROTOR

Carbon/Carbon Composite Turbine Rotor for Super-Efficient High Temperature Engines



Silicon Carbide Reinforcing Fibers for High Strength and High Temperature Composites

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GaAs TECHNOLOGY

## INDUSTRIAL INVESTMENT IN GaAs DIRECTLY CATALYZED BY DARPA GaAs PROGRAM

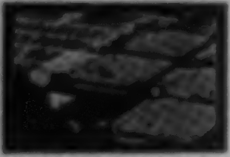
(Date Operational, Building Cost, Equipment Cost)

3/84 LEASED $10 M

9/85 $13 M $14 M

4/85 $6 M $11 M

9/85 EXISTING $16 M



9/85 $9 M $11 M

OTHERS

| | |
|---|---|
| IBM | HP |
| ATT | Tri-Quint |
| TI | Cray |
| Harris | Pivot |
| | Vitesse |

| FY | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DARPA | [illegible] | [illegible] | [illegible] | [illegible] | $1.7 M | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | $43.2 M |
| SDIO | | | | | | | | | | | | $22.0 M | $22.0 M |

# PROJECTED TECHNOLOGY TRANSITIONS
## FY 1986 AND 1987

| TECHNOLOGY | RECIPIENT |
|---|---|
| ARIADNE | Navy |
| Submarine Laser Communications | Navy |
| ACSAS | Navy |
| X-29 Advanced Technology Demonstrator | Air Force |
| X-Wing/RSRA | NASA/Navy |
| AMBER | Army/Navy |

## CURRENT EMPHASIS

- Aeronautical research
- Strategic aircraft and cruise missiles
- Armor/anti-armor research
- Anti-submarine warfare
- Computing technology
- Tactical applications of directed energy
- Materials research

## ACCOMPLISHMENTS
### FY 1985

| TECHNOLOGY TRANSITIONED | RECIPIENT |
|---|---|
| Rapid Solidification Research – Supersteels | Navy |
| Silicon on Insulator Research | Air Force |
| Space Nuclear Power, Alpha, Lode, Talon Gold, Particle Beam Research, Gallium Arsenide Research, Kinetic Energy Weapons, High Energy Laser Optics, Free Electron Laser, Infrared Surveillance Technology | SDIO |
| Radar Bistatic Alerting and Cueing | Army |
| Vacuum Arc Double Electrode Remelt (VADER) | Army/Air Force |
| Low Cost Training Simulators | Army |

## PREPARED STATEMENT OF LT. GEN. JOHN L. PICKETT, USAF, DIRECTOR, DEFENSE NUCLEAR AGENCY

Mr. Chairman and Members of the Committee:

I am Lieutenant General John L. Pickitt, Director of the Defense Nuclear Agency (DNA). It is a pleasure to appear before the subcommittee to report on DNA's progress over the last year and to discuss programs proposed for fiscal year (FY) 1987.

The underpinning of our national security has been, and remains today, a fundamental policy of deterring conflict. Should deterrence fail, our policy is to respond at a level of our choosing with surviving retaliatory capabilities sufficient to terminate the conflict on terms favorable to the United States and its Allies. This policy forms the foundation of U.S. military strategy, doctrines, tactics; and it determines how we equip and employ our military forces.

An array of factors comes into play in the course of planning for the modernization and employment of these forces. Prominent in that array are survivability, control, and weapons effectiveness. To support national security policy, our forces must be ready to fight after an attack; they must be able to receive and act on the directions of higher authority; and their weapons must be delivered accurately with high probability of target damage.

These interrelated factors--force survivability, force control, and weapons effectiveness--are central to DNA's mission and activities. DNA's tasks are formulated and carried out to improve the survivability, control and effectiveness of U.S. military forces, and those of its NATO Allies, during and following conflict at all levels of intensity. The Agency, through the RDT&E program we will present today, furnishes the nuclear effects technology and engineering methodology with which systems designers, operational planners, and commanders at all levels implement the policy of deterrence and retaliation. We believe that DNA's role in support of that national policy is a vitally important one.

Requirements within the Department of Defense for DNA support have continued to increase, but we are finding it increasingly difficult to provide that support in today's fiscal environment. The agency's budget request last year was $384.4 million, an amount which this subcommittee and your parent committee recommended for approval. Our request was reduced by $10 million during the authorization conference process, setting DNA's RDT&E authorization at $374.4 million. The agency's share of Congressionally directed undistributed reductions was $22.6 million, which coupled with an earlier appropriations reduction of $0.8 million to diminish the agency's FY 1986 RDT&E program to $351.0 million. After the expected $32.9 million reduction in March for Gramm-Rudman, the agency's FY 1986 effective RDT&E funding will be $318.1 million.

The net effect of these deep and severe reductions has been a major disruption in DNA programs. Practically every major program in the agency will suffer reduced effort and stretchout. Some key efforts will be terminated and future technology development will be crippled.

The DNA budget request for FY 1987 is $347.0 million, representing a 4.84 percent negative real growth over the pre-Gramm-Rudman FY 1986 funding allocation of $351.0 million. Our FY 1987 request is based on minimum essential requirements. It cannot be reduced without acutely impairing our ability to support national security requirements.

## STRATEGIC FORCES

In discussing the overall DNA program, I will address strategic forces first, follow with the Agency's non-strategic forces work, and conclude with an update of our nuclear effects technology base efforts.

### INTERCONTINENTAL BALLISTIC MISSILES (ICBMs)

DNA has dedicated a significant portion of its RDT&E resources toward enhancing the survivability and control of land-based strategic missiles. The Agency's current efforts and plans focus on the Small ICBM and the PEACEKEEPER, and on their candidate basing options. We are engaged in a jointly funded, three-year effort with the Air Force to illuminate and resolve uncertainties in Small ICBM basing survivability. The joint program has already provided answers to many of the survivability questions we faced at its start in FY 1983.

Small ICBM Mobile Basing. One major uncertainty impacting early design of the Hardened Mobile Launcher (HML) was definition of the so-called non-ideal airblast created when a nuclear blast wave propagates through a high sound speed layer near the earth's surface. Such layers are formed by thermal radiation from the fireball interacting with flat, barren terrain such as that in the southwestern U.S., a candidate HML basing area. We knew from atmospheric nuclear tests that intensified aerodynamic forces were present in the non-ideal shock wave, but we did not know exactly how they evolved nor could we describe them in enough detail to support a survivable HML design. Through an intense theoretical and calculational program, DNA gained a detailed understanding of how and why the aerodynamic forces of the non-ideal airblast develop, behave, and impose loads. We have furnished environmental descriptions of the non-ideal airblast to the Air Force and its HML contractors, and plan to complete this work during this fiscal year with any necessary refinements to follow.

DNA has developed two successful test beds for HML airblast testing. The first of these techniques employs a high explosive to generate the shock wave and a helium-filled plastic bag to provide high sound speed characteristics similar to those of the thermally heated layer of air. In June 1985, we executed the MINOR SCALE event during which we observed the helium layer transform the ideal shock wave into the turbulent flow characteristic of a non-ideal airblast. Models of the HML embedded within the helium layer experienced non-ideal shock loading similar to that which the models would encounter under attack. DNA has planned a second such test for May 1987, early in the planned full-scale development of the Small ICBM. HML will be one of the major experiments on this test. The second test bed features an 825-foot long cylindrical shock tube 20-feet in diameter. It uses a high explosive to generate a planar shock wave and can incorporate helium bags for repetitive non-ideal airblast tests of small scale HML models at relatively low cost.

Superhard Silo Basing Technology. The Scowcroft Commission recommended a technology development program for potential basing of PEACEKEEPER and the Small ICBM in superhard silos, a recommendation subsequently approved by Congress. As part of its joint program with the Air Force, DNA has reexamined nuclear cratering, developed test techniques emulating airblast and ground shock from nuclear bursts, and investigated innovative techniques to enhance silo and shock isolation system survivability.

We undertook the nuclear crater reevaluation by a methodical scientific program to obtain relevant data from craters in the Pacific; by conducting several specially designed high-explosive tests and two underground nuclear tests, MINI JADE in May 1983 and MILL YARD in October 1985; and by correlating the combined test and Pacific results with the complex models that predict crater-related quantities. Our results provided solid evidence confirming: (1) that the portions of the Pacific craters that affect silo survivability are substantially smaller than earlier implied; (2) that both nuclear and high explosive tests confirm the first observation; (3) that observations of smaller relevant crater dimensions in the Pacific apply to continental geologies; and (4) that the modern numerical codes used to describe the dynamics of crater formation accurately predict the foregoing observations.

In its test program of the past year, the Air Force employed DNA-developed methodologies to test silos to airblast effects from airbursts. We have also made steady progress in reproducing the violent disturbances which would exist in subsurface media near a surface detonation. A series of preliminary tests has successfully validated individual features of the technique, aiming toward a crucial proof test in April of this year that will combine those individual features for simulation of surface burst stresses. DNA is conducting a linked theoretical and experimental program to explore the ways in which silo hardness in sites with inefficient ground shock transmission (such as dry soil) can be extended to sites with relatively enhanced transmission properties (such as wet soil or rock). Our current objectives are to investigate whether structures surrounding silos can favorably alter shock characteristics to enhance silo hardness independent of site geology, and to design innovative shock isolation systems to decrease rattlespace requirements.

## STRATEGIC MISSILE INFLIGHT SURVIVABILITY

Nuclear detonations pose a distinct challenge to strategic missile survivability. Since the early 1960s, DNA has provided strategic missile designers a proven approach to inflight survivability, an approach coupling sophisticated analytical models, radiation tests in DNA's laboratory radiation sources, and underground nuclear effects tests.

Analytical Models. DNA develops, improves, employs, and provides the theory of nuclear weapon effects on strategic missiles. The theory is continually updated and transformed into numerical codes which predict the response of various elements of missiles to a range of nuclear stimuli. Two examples are the structural response of reentry systems to nuclear radiation effects and models of electronic system behavior during and following radiation exposure.

Laboratory Radiation Sources. One method of inflight survivability testing uses laboratory sources of pulsed nuclear radiation. Our AURORA facility provides pulses of ionizing radiation emulating gamma ray effects in objects with dimensions typical of missile guidance systems. We also operate the ARES facility which is capable of exposing entire missile bodies to an electromagnetic pulse. We conduct aggressive research programs to upgrade these and our other facilities through technological advances in electrical energy storage, switching, and conversion to radiation. The schedules for these facilities in fiscal years 1986 and 1987 include radiation testing of PEACEKEEPER, TRIDENT II, and the Small ICBM. The full-scale PEACEKEEPER missile is programmed in fiscal year 1986 for electromagnetic pulse tests, to be followed in fiscal year 1987 by similar TRIDENT tests.

Underground Nuclear Effects Tests. DNA is the sole government agency chartered to manage underground nuclear effects tests, the only realistic method of verifying system performance in some nuclear environments. We conduct these tests in conjunction with the Department of Energy.

In April 1985, DNA conducted the underground nuclear test MISTY RAIN at the Nevada Test Site. MISTY RAIN provided critical data on both the mechanical and electrical survivability of the Mk 21 reentry vehicle for PEACEKEEPER and the Small ICBM. TRIDENT II and other PEACEKEEPER components were also exposed during the test. We plan one additional underground test in fiscal year 1986 with strategic missile inflight survivability as its principal objective. The MIGHTY OAK event, scheduled for April 1986, will include Mk 21 reentry vehicles and supporting experiments for assessment of both their electrical and mechanical survivability. Also to be exposed are elements of the TRIDENT II missile and its Mk 5 reentry body, and hardware for the Small ICBM. The MIDDLE NOTE and MISSION CYBER events, scheduled for December 1986 and May 1987 respectively, are the key tests of the TRIDENT II missile and its Mk 5 reentry system. The MIDDLE NOTE test configuration includes a low yield nuclear device and other features that permit us to provide the test environment at significantly reduced costs.

Reentry Vehicle Technology. One important aspect of our reentry vehicle technology work is its application to dust erosion of reentry vehicle heat shields. Erosion can seriously degrade accuracy or cause a loss of heat shield integrity. During the MISTY PICTURE event, we plan to conduct an experiment that should provide a pragmatic measure of dust erosion effects. We plan to continue our efforts to predict the location, concentration, and size distribution of dust lofted by nuclear explosions. Resolution of this issue is needed to reduce uncertainties in reentry vehicle fratricide from the dual U.S. perspective of both defender and attacker. DNA also conducts investigations of reentry vehicle antenna windows to improve their responses to x-ray loading and to improve the survivability of the large windows that may be needed for maneuvering reentry vehicles.

## MANNED AIRCRAFT AND CRUISE MISSILE SURVIVABILITY

Our strategic manned aircraft depend on tactical warning and dispersion for launch and base escape prior to arrival of a nuclear attack. Because an attacker has difficulty in locating airborne aircraft precisely enough to execute a successful nuclear attack, many nuclear effects of concern to air-breathing strategic forces deal with the longer term consequences of nuclear detonations, such as dust erosion of engines or flight through radioactive clouds.

Of potentially major impact on air-breathing strategic systems is DNA's assessment of dust ingestion in modern aircraft engines. The concern here grows from observed aircraft engine malfunctions following injection of dust into the atmosphere by volcanic activity, notably the eruptions in Washington and Indonesia. In FY 1985, we completed dust ingestion tests of one type of engine used in strategic aircraft and began work on a second. Our FY 1987 work in this area will concentrate on advanced turbofan engines.

One of DNA's major initiatives relevant to manned aircraft survivability is the development of automated techniques to identify the location and radioactive intensity of nuclear clouds. This will afford strategic planners an opportunity to program flight paths through areas expected to be relatively clear of contaminants, a predictive capability especially valuable for missions of long duration as, for example, those of airborne command posts.

In FY 1986, we anticipate downsizing the program for microcomputer compatibility, thus promoting its wider availability.

## STRATEGIC NUCLEAR WEAPONS EFFECTIVENESS

As the Soviet strategic target structure has evolved, we have had to include an increasing number of issues relative to strategic planning. We are investigating for the Department of Defense both technological alternatives and operational methods to achieve required damage against this changing target inventory.

We have recently begun investigating two alternatives for enhancing nuclear effects against hardened Soviet underground structures. One issue being investigated is the relative coupling of bursts near the surface, initiated by proximity fuzes, versus true surface bursts controlled by contact fuzes. A second initiative deals with earth penetrating nuclear weapons for strategic applications. Past work on earth penetrating warheads has concentrated on relatively deep penetration carrying a weight penalty for warhead protection equating to a penalty in nuclear yield. Recent DNA energy coupling calculations indicate that even very shallow penetrations can dramatically increase coupling relative to a surface burst. Reductions in weight/yield penalties may be possible. We plan to refine these calculations over the next two years and obtain corroborative data through an experiment during an underground nuclear test.

## STRATEGIC COMMAND, CONTROL, AND COMMUNICATIONS ($C^3$)

The communications paths and facilities required for control of U.S. strategic forces are susceptible to nuclear effects in a number of ways. Transmitter and receiver sites can be destroyed by direct attack since their locations are well known. Systems in space are subject to electronic subsystem failure from exoatmospheric detonations even though the spacecraft themselves may be undamaged physically. More subtle is the degradation of transmissions through environments disturbed by nuclear effects that affect all frequencies in varying magnitudes and durations.

Polar Communications. Of particular interest to bomber communications is the problem of transmission degradation in the Arctic regions traversed by bomber fly out routes. DNA employs satellites in polar orbits to investigate transmission through disturbances produced by natural causes, such as auroras, with many signal degradation characteristics similar to the nuclear case. Currently, the HiLat satellite is on orbit as a transmitter for these tests. We are participating in a second satellite program, POLAR BEAR, planned for a September 1986 launch. POLAR BEAR's infrared and optical imaging capabilities will help us define the environments through which the HiLat transmissions propagate. We use computer simulation of these satellite downlinks to aid in extending results from natural disturbances to the nuclear environment.

Communications Satellite Survivability. DNA continues to evaluate weapon effects to determine guidelines for nuclear hardening of satellite electronics. Our laboratory radiation sources are used by satellite design agencies for evaluating the viability of their designs, and our radiation effects research program is developing hardening methodologies for the Very High Speed Integrated Circuit (VHSIC) technology. During the MISTY RAIN underground test of May 1985, DNA exposed a representative communications satellite memory circuit and observed spurious state changes that would cause scrambling of stored data and instructions. We are currently working with the DSCS III program officer and MILSTAR designers to help them assure survivability of the space and earth segments of the system, a crucial future element of survivable communications.

High Altitude Electromagnetic Pulse (HAEMP). The electromagnetic pulse from high altitude detonations (HAEMP) can potentially upset or damage ground based and airborne communications nodes. One of DNA's goals is to develop and provide cost effective methods of hardening communications facilities against this large area effect. We also provide standards and specifications for HAEMP hardening, and have recently initiated a project to assure that the HAEMP hardness designed and built into such facilities remains effective with time, routine maintenance, and improvements. This work directly supports national communications vital to strategic operations.

## NON-STRATEGIC FORCES

I will now briefly describe DNA's contributions to improved nuclear posture for our forces in the European and Pacific non-strategic and indicate our future programs.

### SURVIVABILITY, SECURITY, AND CONTROL

Some of the improvements in non-strategic nuclear force survivability and control follow the same general approach and methodology as used for strategic forces. There are, however, a number of critical differences, among which are potentially shorter warning times, operations in foreign countries, day-to-day coordination with our Allies, and proximate Warsaw Pact forces with a quantitative advantage. DNA formulates and carries out its non-strategic nuclear programs to capitalize on its other activities, accounting at the same time for crucial differences. Security of our foreign based nuclear weapons has received increasing attention as the threats from Pact special forces and from terrorists have grown.

Survivability. Valuable tools for assessing and enhancing non-strategic missile force survivability are the Survivability Evaluation Programs DNA participates in with the responsible Services. In FY 1985, we initiated planning for the Pershing II Survivability Evaluation Program (PERSEP), during which we will join in field exercises designed to identify areas for survivability improvements. We will be examining issues such as indicators of impending PERSHING deployment from their garrisons, thermal or acoustical signatures enroute to and at deployment sites, and the ability of covert agents to identify and track the mobile system. In preparation for the FY 1987 exercise, we are now conducting in-depth assessments of PERSHING II procedures and hardware. We are also performing similar assessments for the LANCE and Ground Launch Cruise Missiles, both scheduled for similar exercises in FY 1987.

Our in-theater tactical aircraft are tied to fixed airbases, the locations of which are well known. These bases, and their aircraft when not airborne, are extremely susceptible to surprise attack. We are now initiating an effort to explore the advantages and disadvantages of dispersal of theater-based aircraft to gain nuclear survivability. The project, to continue into FY 1987, will assess the operational, logistical, communications, and maintenance aspects of potential aircraft basing in European areas affording aircraft concealment.

DNA provides test beds and other technical support for the Services' evaluation of the nuclear survivability of their non-strategic weapons systems. Our MINOR SCALE high explosive event included tests of the vulnerability of tanks, armored personnel carriers, and other vehicles to airblast effects. Our Thermal Radiation Simulator has been used for evaluating the thermal protection afforded personnel and equipment by new types of fabrics and coatings. It was fielded on MINOR SCALE to permit combined thermal and airblast tests. The FY 1987 high explosive event MISTY PICTURE will offer an additional test bed.

AURORA, one of DNA's laboratory radiation sources mentioned earlier, was recently modified to accommodate the Abrams tank and Bradley fighting vehicle, both scheduled for radiation testing at AURORA in FY 1986. We are constructing, in cooperation with the Navy, the EMPRESS II simulator for Navy tests of surface vessel high altitude electromagnetic pulse survivability. This barge-borne simulator is programmed to go into operation in FY 1987 for an assessment of the DDG-51 class of destroyers.

Non-Strategic Nuclear Weapons Storage and Security. Our non-strategic nuclear weapons are in place to deter aggression and to serve, if necessary, as a counterbalance for quantitatively superior Warsaw Pact forces. Unique policies, procedures, and facilities are required to ensure that they are available if needed, but remain safe and secure in peacetime and survivable in wartime. The growing threat of international terrorism has added momentum to this effort.

DNA is currently engaged in preparing "An Illustrative Posture For The Future Storage and Transport of Nuclear Weapons in Allied Command Europe."

This work, chartered by the NATO Senior Level Weapons Protection Group, is designed to provide a planning document to guide future development programs. We expect to complete this benchmark task in FY 1986, with its implementation and refinement continuing into FY 1987. We anticipate that it will evolve as a living document against which we can judge the merit of proposed development programs, improved procedures, and proposed hardware or facility improvements.

In FY 1985, DNA completed demonstration of an improved nuclear weapons upload system, comprised of both procedures and hardware, for nuclear weapon storage sites. Related tasks, either underway or planned, include demonstration of weapon storage vaults for Army nuclear weapons; an evaluation of caves, tunnels, and other underground structures for non-strategic nuclear weapon deployment; development of a prototype secure and survivable trailer for employment with Navy weapons; and evaluation of advanced sensors and robotics for their potential to improve security at storage sites. DNA has begun a very important project to transfer the lessons learned and technology developed for the European theater to the Pacific theater. We expect it to continue through FY 1987.

Theater Command, Control, and Communications ($C^3$). DNA's work in improving the nuclear survivability of in-theater communications is accomplished jointly with theater commanders, the individual Services, and elements of NATO. In our demonstrations of survivable $C^3$ concepts, we focus on a combination of hardening, mobility, and dispersion coupled with radio frequencies relatively immune to the nuclear effects that impede signal propagation.

As part of the FY 1985 military exercises in Europe, we demonstrated a microcomputer based $C^3$ system that enabled major reductions in the time required to plan and execute simulated tactical nuclear missions. In a second exercise, conducted with the 9th Infantry Division in Washington, we attained proof-of-principle of the Survivable Command Information Liaison System (SCILS), which links Army field communications systems with microprocessors. SCILS enabled the division headquarters to perform its function even though its elements were dispersed in cells separated by distances affording nuclear survivability. In FYs 1986 and 1987, we plan to develop and demonstrate in Europe a highly survivable ground wave communications system with a low probability of intercept and mobile capabilities permitting dispersal for nuclear survivability. Beginning in FY 1986 and continuing into 1987 is development of a survivable communications system to process battlefield information and nuclear targeting data. This effort is an extension of our earlier work to reduce the time required for tactical nuclear mission planning and execution.

DNA is assisting the Pacific Command (PACOM) in assessing the EMP survivability of critical communications facilities in the Pacific. We are using a low-level EMP simulator to evaluate the cost implications of maintaining life cycle survivability in PACOM facilities previously hardened to EMP. A future payoff of this work will be development of specifications and standards to preserve the facilities' EMP hardening over time, and applications of those specifications and standards to similar installations worldwide.

NUCLEAR EMPLOYMENT PLANNING

DNA's work in nuclear employment planning enhances U.S. and NATO nuclear planning and execution capabilities. One primary thrust is automation of the methodologies used to plan and execute non-strategic nuclear warfare; a second is assessment of target vulnerabilities.

Automated Non-Strategic Nuclear Planning. At the request of the Supreme Headquarters, Allied Powers Eurpoe, DNA performed the tradeoffs and employment evaluations underlying the Montebello decision to reduce the inventory of nuclear weapons in Europe without degrading NATO operational effectiveness. The agency continues to participate in the Nuclear Weapons Requirement Study (NWRS) process by providing essential ingredients for the annual study. We have made significant improvements in automation and integration of the NWRS software that evaluates nuclear weapons requirements to attack fixed targets. In the future, we plan to upgrade that software to incorporate terrain effects and nuclear requirements for attack of mobile and maritime targets.

Some of our tasks in non-strategic nuclear planning are designed to assist lower echelon activities. We will use the technology developed for the highly successful Target Analysis and Planning System (TAPS) to automate nuclear planning at an Air Tactical Operations Center (ATOC). This work, being planned in conjunction with the U.S. Air Forces in Europe and Allied Air Forces, Central Europe, will modernize nuclear mission planning in nuclear environments. We also develop hand held calculator programs and slide rules that provide estimates of target damage for theater commanders and planners. In the future, we expect to add a capability to calculate nuclear effects such as electromagnetic pulse.

Warsaw Pact Vulnerabilities. The evolution of Advanced Conventional Weapons (ACWs) could make them available for non-strategic employment against Warsaw Pact ground forces. Questions have arisen concerning these target seekers as a means to reduce reliance on non-strategic nuclear weapons. We are currently using intelligence estimates of typical Pact force deployments to evaluate their vulnerabilites of both ACW and non-strategic nuclear weapons under a set of otherwise constant conditions. Important spinoffs from this vulnerability assessment, scheduled for completion in FY 1987, are relative collateral damage and synthesis of more effective employment modes for both weapon families.

We determined the airblast vulnerability of armored vehicles during the MINOR SCALE test. We plan in the future to assess the underwater shock vulnerability of submarine designs through high explosive tests.

DNA strives continually to reduce the uncertainties inherent in target vulnerability and damage assessments. The spread of fires started by nuclear detonations and damage to forests are two areas on which we plan to focus in the future.

## NUCLEAR EFFECTS TECHNOLOGY BASE

DNA's contributions to the survivability, control, and effectiveness of strategic and non-strategic forces, as portrayed in the preceding discussions, are made possible by the agency's nuclear effects technology base. A key element in DNA's mission is, therefore, the application, transfer, and update of nuclear effects technology. In this statement so far, we have indicated some areas in which technology updates and modernization are on-going or planned. There are, however, some additional technology base topics deserving elaboration.

### TECHNOLOGY APPLICATIONS AND TRANSFER

In September 1983, the Department of Defense issued an instruction (DODI 4245.4) requiring the Services explicity to include nuclear survivability as a topic in their presentations to the Defense Systems Acquisition Review Council (DSARC). That publication charged DNA with responsibility for assisting the Services through development and transfer of relevant nuclear effects information to the Services. We do this by reviewing the status of systems survivability plans during, if possible, the system's conceptual phase, and we follow through with recommendations as the hardening is incorporated during subsequent phases of system development. We have recently begun dialogues with the Services' Operational Test and Evaluation organizations to help them confirm that required survivability has indeed been realized. We publish newsletters, conduct symposia, and offer specialized courses to help systems designers remain abreast of the state-of-the-art.

DNA's nuclear effects technology application and transfer task is additionally implemented through the agency's operation of centers for information retrieval and dissemination, and through publication and update of the EM-1 manual, the fundamental source of nuclear effects data within the Department of Defense. In conjunction with the Veterans Administration and other governmental agencies, we have reconstructed the radiation doses likely to have been received by Department of Defense personnel participating in atmospheric nuclear tests from 1945 through 1962.

## TECHNOLOGY UPDATE

Perhaps the most powerful tools available to DNA's nuclear effects technology work are complex numerical codes which describe many aspects of nuclear environments and evaluate methods of hardening against them. These codes are extremely sophisticated, rivaled only by those developed by the national laboratories for their nuclear weapons development activities. Rather than replicate the hardware required for such calculations, DNA provides at the Los Alamos National Laboratory a central scientific computational capability for those performing our nuclear effects work. For our unclassified computing, we have installed telecommunications links permitting use of the computers without the expense and delay of travel to Los Alamos. In FY 86, we are working strenuously to extend this capability to include a secure telecommunication links to the Los Alamos National Laboratory that will permit classified calculations without an on-site presence by those responsible for the calculations.

We have, in cooperation with other government agencies, instituted a research program looking at all the significant uncertainties in climate effects resulting from nuclear war. The newest addition to the program will begin this summer with large scale field experiments using specially instrumented aircrafts. These aircraft will investigate fire flume dynamics and smoke chemistry from large wildland fires being set for other purposes such as watershed improvement or pest control.

One of DNA's subordinate organizations is the Armed Forces Radiobiology Research Institute in Bethesda, Maryland. At this facility, physicians, radiology experts, and other scientists assess the combat performance capabilities of military personnel in nuclear environments, develop methods for mitigating those effects, and help educate and train Service personnel in preventive measures.

## CONCLUSION

We have provided to you in our normal budget submission additional details of the 17 projects comprising DNA's RDT&E program.

| Project Number | | FY 1986 Estimate | FY 1987 Estimate |
|---|---|---|---|
| 6.27.15.H | DEFENSE NUCLEAR AGENCY (DNA) | 350988 | 347013 |
| A | Aerospace Systems Vulnerability & Hardening | 14500 | 17700 |
| B | Atmospheric Effects & Mitigation | 13600 | 20600 |
| C | Command, Control & Communications ($C^3$) | 6600 | 10600 |
| D | Vulnerability/Assessment & Data Evaluation | 44288 | 26713 |
| F | Nuclear Survivability & Security | 18900 | 18700 |
| G | Effects Testing Using Simulators | 19500 | 22700 |
| H | Effects Testing Using High Explosives | 4000 | 8600 |
| I | Effects Testing Using Natural Disturbances | -0- | -0- |
| J | Underground Nuclear Tests | 90100 | 111400 |
| L | Laboratory Radiation Simulator Development | 11300 | 11700 |
| M | Biomedical Effects | 21400 | 21600 |
| N | Tactical Systems Vulnerability & Hardening | 12400 | 13600 |
| O | Strategic Nuclear Implications & Assessments | 7400 | 6100 |
| P | Physical Security | -0- | -0- |
| S | Strategic Structures Vulnerability & Hardening | 39200 | 29800 |
| V | Nuclear Effects on Electronics | 17900 | 27200 |
| W | Small Business Innovation Research | 2500 | -0- |
| Z | Special Projects | 29900 | -0- |

As we reported to you last year, we also manage the lethality and hardening program for the Strategic Defense Initiative Office (SDIO). DNA was assigned this tasking because the scientific understanding required dovetails with that inherent in nuclear weapons effects, and because of our successful track record in managing such closely related work.

Mr. Chairman, the personnel at DNA are totally dedicated to their work. They rightfully feel, as I do, that we have a mission at the core of national security, and that we meet the challenge of that mission through technical and managerial excellence. This completes my prepared statement. I would be happy to address any questions you may have.

**Mr. Hertel.** Thank you very much. The meeting is adjourned.

[Whereupon, at 4 p.m., the subcommittee was adjourned.]

# NAVY R&D BUDGET FOR FISCAL YEAR 1987

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House of Representatives,
Committee on Armed Services,
Research and Development Subcommittee,
*Washington, DC, Tuesday, February 25, 1986.*

The subcommittee met, pursuant to call, at 10:15 a.m., in room 2118, Rayburn House Office Building, Hon. Melvin Price (chairman of the subcommittee) presiding.

## STATEMENT OF HON. MELVIN PRICE, A REPRESENTATIVE FROM ILLINOIS, CHAIRMAN, RESEARCH AND DEVELOPMENT SUBCOMMITTEE

Mr. **Price.** The subcommittee will come to order.

This morning, the subcommittee will review the Navy's request for $10.6 billion for its fiscal year 1987 RDT&E Program. This request for authorization represents a 25.3-percent increase over last year's appropriation for the Navy program.

Our principal witness this morning is the Honorable Melvyn R. Paisley, the Assistant Secretary of the Navy for Research, Development, accompanied by Vice Adm. Albert J. Baciocco, Jr., USN, Director, Research, Development, and Acquisition.

Mr. Secretary, I can say with a high degree of confidence that the Navy request will be sharply reduced between now and the appropriations process. This reduction will come as a result of budget constraints.

Additionally, Mr. Secretary, I will add that there is a great deal of concern over the Navy's indifference toward the congressional process. I am advised by the Comptroller General in a letter of February 21, 1986, that the Navy has misappropriated funds for the Rankine Cycle Energy Recovery System as well as other programs.

I wonder if you can give us a little touch on that before you start with your prepared statement.

During the course of this past year, we have been advised of problems with the avionics racks that are used in your tactical aircraft. We have been advised of a system that will solve the problem, and my understanding is that you gave the system, referred to as the Boxmount, very high marks. Yet, some of your people have not only ignored the problem but indeed advised the Boxmount contractor to "stay away from Secretary Paisley and the Congress."

Do you want to comment on that?

## STATEMENT OF HON. MELVYN R. PAISLEY, ASSISTANT SECRETARY OF THE NAVY FOR RESEARCH, ENGINEERING AND SYSTEMS, DEPARTMENT OF THE NAVY, ACCOMPANIED BY RICHARD L. RUMPF, PRINCIPAL DEPUTY ASSISTANT SECRETARY FOR RESEARCH, ENGINEERING AND SYSTEMS; MAJ. GEN. RAY "M." FRANKLIN, U.S. MARINE CORPS, DEPUTY CHIEF OF STAFF FOR RESEARCH, DEVELOPMENT AND STUDIES, HEADQUARTERS, U.S. MARINE CORPS; COL. HARRY BLOT; JOHN J. KEANE; AND RICHARD METREY

Mr. PAISLEY. Let me make a comment about that. I think that there has been a rack proposed that can improve the reliability. I firmly believe that myself.

To be frank with you, I thought it was moving along a little better than it is. I think what I should do is make a commitment to you to give you a report on our evaluation and the status of that, so I get a firm commitment to come back to you to do that, because I agree with your view on this. So, I will make that commitment to do that.

If I understood you earlier, your earlier question was associated with that letter that we just received on RACER. Did I understand you correctly?

Mr. PRICE. Mr. Battista has a little comment on that.

Mr. BATTISTA. I have the letter here, dated February 21, and also attached is a letter to Secretary Lehman, and the charge is that the Navy has indeed misconstrued—which is another term for "misappropriated"—the funds authorized for the RACER system, and indeed did not comply with the design criteria which the Secretary certified to on the DDG-51, to ensure compatibility. It talks about other systems; for example, the MK-92.

On the Boxmount problem that the chairman raised, just to get you into the right direction, one of your program managers advised the contractor that he was "screwing up his program;" that he was committed to the existing contractor. And it is my understanding that you are going to go ahead and spend $37 million to try to fix the old rack; and the new rack was evaluated by Navy aviators in the S-3, and they gave it the highest of high marks. And they were also told to "stay away from Secretary Paisley and the Congress, if you really want to do business with the Navy."

You might go back to NAVAIR, your Systems Command, and probe into that, because this is really a crying shame. You have got S-3 aircraft, the principal problem being reliability, as a consequence of the incompatibility of the equipment with the racks, and here you have got a solution in hand.

Mr. PAISLEY. Yes, I will do that.

[The following information was received for the record:]

Prototype modular, floating beam avionics racks (trade name "Boxmount") are produced by Hollingsead International, Inc., of Santa Fe Springs, California. They have been provided to the Navy at no cost and were evaluated in the right-hand aft external avionics bay of an S-2A at the Naval Air Test Center in April 1982, and in two S-3As at the Fleet Readiness Squadron, Naval Air Station, North Island in October 1982. No commitments were made by the Navy to use Hollingsead as a sole source for any avionics racks procured by the Navy.

As a result of these favorable evaluations, a budget request was submitted in 1983 for FY 1985 budget funding to support an engineering change proposal (ECP) for replacement of the present avionics rack in the right-hand aft external avionics bay of all S-3 aircraft. APN-5 funding was granted at $2.134M in FY 1985 and $1.785M in FY 1986 for a total procurement of 160 kits.

The ECP was submitted by Naval Supply Center Oakland in December 1984 and approved by the NAVAIR Aircraft Configuration Control Board on 30 May 1985. The request for proposals (RFP's), which has a generic specification and includes the requirement for a competitive procurement, was issued 13 February 1986 by Naval Supply Center Oakland. Contract award is anticipated by July 1986.

Hollingsead International, Inc., has been frequently advised on the budgeting, engineering change, and government procurement processes that are required prior to award of a contract. Any proposal that Hollingsead submits in response to the competitive RFP will be given every proper consideration in accordance with the competitive source selection procedures.

Mr. PRICE. Bob, do you have any statements?

Mr. BADHAM. No.

Mr. PRICE. All right, Mr. Secretary.

Mr. PAISLEY. In regard to that letter on RACER, I just received that this morning. We haven't officially received it yet. But I think probably the bottom line is you are probably correct on what was said, and we are going to have to respond to you as to what we are going to do about that, because I suspect that there is a lot of truth in what that report says.

Our evaluation, we had our legal counsel look at that before and I think that basically we went down the road—we went down thinking that we were doing, if not the proper thing, the legal thing. And there is some question now whether that is true. So we will go back. I will read that and we will take a reaction to that and do something on it.

As I mentioned—if there aren't any other questions from any of the Members—I have submitted my statement for the record. I will start out and cover a few points. I want to thank you for introducing the witnesses here, who are members of the Marine Corps and also the Navy.

This is my fifth year over here, and I have always enjoyed coming over. We have a lot of interesting discussions here. I think we have accomplished a lot between us.

I have brought four speakers to specifically talk on the agenda items, and to that end we will try not to take any questions to be answered for the record but try to give you answers here on the spot.

In my statement that I have submitted to you, there are three items that I would like to highlight from a management initiative viewpoint. We have a new program that we initiated a little over a year ago, for our acquisition officers in the Navy. It is called Material Professional designator. We have over 900 military officers in it. One-third of all of our admirals' billets are designated for that specific designator Material Professional. I think it gives a career path for those officers.

I would like to think if we look into the future, you might see some of the same for the other services. We feel very good about the program, and we think we are going to have committed professional acquisition officers in the Navy.

Another issue over the last several decades——

Mr. PRICE. Mr. Paisley, will you suspend for just a minute while I recognize the fact that we have with us this morning also General Smith and General Franklin from the Marine Corps. In case you get into trouble, they are here to help you.

Mr. PAISLEY. As we go through the agenda, and as the speakers come up, I will introduce them.

Over the last couple of decades, we in the Department of Defense, I believe, have gone through several cycles of acquisition. We have gone from the case where we have maximum risk for the contractors using total package procurement plan to maximum risk for the government cost plus contracting. We think that we have developed in the Navy a policy of balanced minimum risk.

This policy that we have just released will start out with two or more contractors on a cost plus contract in the early development phase, and it is in this phase that prototyping can be done.

As we go to the full-scale engineering phase, phase 2, we will have a contractor team, one of them being the design leader. That contract will be on fixed price, and we will get not-to-exceed options for production.

The two contractors will develop the system together, and both of them will enter production prepared to compete with each other for the production buys that were submitted on the not-to-exceeds.

We think that in what we have done, we have a balanced investment by the Government and the contractors. The Government pays for the R&D tooling, refurbishment of that tooling for production, and acceptance test equipment. We ask the contractors to pay for the production tooling and the test equipment for production.

The Secretary of the Navy must approve all changes as we go into past milestone 3. We must fully fund the programs in our POM, and we must have a maximum simplification in the specification. We have a specification advocate to certify that. The CNO must certify that the requirement that we are working to is a minimum requirement in terms of what the service needs.

I feel that we now have a policy. It is being used on many programs: The V-22, which we are going to talk about today is one of them; the T-45; the A-6; the F-14. It is a policy that I think will get more for our dollars.

One final item. There has been a lot of concern about surge capability. We are looking at the MK-46, the Sidewinder and the Sparrow as test cases. On the MK-46, we asked the contractor how long and how much money it would take for him to increase the production rate ten fold in an emergency. He said about $22 million and 24 months.

We went in and looked very carefully at the things you could do to help him. For instance, the 24-month problem was caused by things like shelf life of 20 years. In wartime, you could reduce that to a year or two. We looked at the test procedures that he was using. We looked at some of the constraints on his factory caused by OSHA and EPA.

Looking at those things, talking to him about the waivers we might be able to get, he then came back and said, "I can do that now for about $7 million, and I could do it in about 2 months."

We think we are going to get the same kind of results out of Sidewinder and Sparrow. I sincerely think that what we are going to see is the rest of the Department of Defense using the same philosophy and developing specifications and test procedures that will be used in wartime.

To be sure that this is a practical solution, we are going to build some torpedoes, following this procedure, and then test them. If it works out, we are going to then shelve the specification and be prepared in war emergency to up the rate.

I think there is going to be a big payoff in this, in terms of surge capability. So I look forward here to a program that will yield production capability in wartime that we will certainly need on our stores and weapons.

With that, I would like Vice Admiral Baciocco to show you a few budget charts before we go into the agenda.

[The statement of Mr. Paisley follows:]

# PREPARED STATEMENT OF HON. MELVYN R. PAISLEY

Mr. Chairman and members of the Committee, I am pleased to appear before this subcommittee again to present the Navy's FY 1987 research and development program and budget. With me today at the table are: Vice Admiral Albert J. Baciocco, Jr., United States Navy, Director, Research, Development and Acquisition for the Chief of Naval Operations; Major General Ray "M" Franklin, United States Marine Corps, Deputy Chief of Staff for Research, Development and Studies; and Mr. Richard L. Rumpf, my Principal Deputy. My statement is structured in two parts. The first part discusses our accomplishments in the Navy's Research and Development program. It then discusses the technology base that underlies the Navy R&D program and the manner in which we insure that the R&D program supports our maritime strategy in responding to the threat. It closes with an exciting report on initiatives we have begun to better mobilize America's industrial capability. The second part gives examples from our mission areas of programs in the R&D budget that support this strategy and show our efforts to inject better management and accountability in all programs.

## .I.

## ACCOMPLISHMENTS IN THE NAVY R&D PROGRAM

Never since the days of Theodore Roosevelt have the Navy and Marine Corps exhibited such a strong consensus on the comprehensive strategy which now forms our naval planning for research and development. We have stopped chasing R&D rainbows. The FY 1987 request for RDT&E is $10,586.8M, 10.2 percent of the Navy's total request. It represents the accomplishment of the pledge made five years ago to inject better management into our R&D programs; to increase funding when there is a high operational payoff at affordable cost; and to study ways to better mobilize America's industrial capability.

### R&D MANAGEMENT

To insure that this research and development base is managed cost effectively, the Navy has injected better management into our R&D programs by initiating a number of reforms in the acquisition process that affect both R&D and production. The success these initiatives have shown in reducing cost has gained them considerable Congressional support. I am thinking particularly of Senator Goldwater's hope that the other military services would follow the Navy's example, especially with regard to competition.

These reforms are the product of five years' work, and resulted in a new acquisition policy issued last November.

The ultimate goal of the Navy acquisition process is to achieve improved performance and increased reliability at lowest reasonable cost. We must begin this effort in R&D as it sets the stage for the entire procurement cycle. I believe we can do this through:

- greater use of competition
- earlier use of fixed-price contracts in the R&D cycle; and
- increased contractor investment.

Our new acquisition policy provides a better management tool for ensuring a controlled transition from development to production. We have already begun to see encouraging progress as a result of these measures.

We are also reemphasizing the role that our allies can play in contributing to our R&D efforts.

The New Navy Acquisition Policy

Let me describe our new policy to you. The development cycle of each program begins with a minimum of two contractors performing concurrent, but separate, development up to Full Scale Engineering Development (FSED). This pre-FSED period will include risk reduction, specification streamlining, and cost-capability tradeoff efforts. The objective of these activities is to clearly identify and eliminate those capabilities which provide only marginal military worth when compared to costs and risks.

At the beginning of the FSED period, the contractor field will be competitively narrowed to two contractors developing a system to one design. We will not continue to a Milestone II decision to proceed with FSED until we are satisfied that advanced development has reduced risk sufficiently to enable the contractors to commit to a fixed price type contract that includes not-to-exceed prices or priced production options. These provisions may be waived, however, when the urgency of the operational requirement for a given system dictates that we proceed with risks that would be considered excessive under normal circumstances.

The first limited production buy will be split between the contractors so that each will have the capability to compete equally for rate production.

Once production has been approved, contractors are expected to provide production tooling and test equipment, with the exception of acceptance test equipment, as well as those facilities required for program execution.

Recovery of these investment costs will be accomplished through depreciation and program-related profit in a mutually-agreed business arrangement. Exceptional circumstances, such as the modification of existing Government-owned tooling and test equipment, may require other equitable business arrangements. These recovery methods are similar to those used in the commercial market today.

To ensure effective implementation of this acquisition policy, changes in programs, both in R&D and in production, must be kept firmly under control. Necessary changes in design must be made sparingly. Changes or modifications causing a change to baseline or performance characteristics and which result in a cost increase will be presented for review in accordance with the Navy's Program Management Proposal Process. For systems in production and for those already deployed we will make only block upgrades. Exceptions will be made for safety.

All fixed-price contracts must be fully funded in the POM. Solicitations and contracts will be streamlined to eliminate over-specification and unnecessary requirements. We have an excellent example of the results of our efforts to eliminate over specification. I directed the Navy Specification Advocate General to review the High-Frequency Anti-Jam (HFAJ) Program with a view toward deleting unnecessary specifications. I am pleased to report that this exercise led to deletion of approximately 225 pages of unnecessary specifications, or a 30% reduction.

Gold-plating must be controlled throughout development and production. Off-the-shelf equipment and non-developmental items will be used, whenever practical, to save costly research and development investment. Commonality of parts is required and must be maximized at the subsystem/component level. The larger quantity buys that will result from this commonality will lead to an increased competitive base and greater savings to the Government.

Systems commanders are responsible for the successful implementation of their assigned programs and, as such, will be held accountable. Mismanagement, overspecification and inefficiency must be identified early and eliminated. Micromanagement must be discouraged to the maximum extent possible.

The establishment of the Material Professional community has played an important part in providing a viable career path for those working in acquisition and procurement. Since we established the Material Professional community slightly over a year ago, over 900 Officers, from Commander to Admiral, have been so designated. Approximately one-third of our Flag Officer billets are now set aside for Material Professionals. This year's Rear Admiral selection board reflected this fact. We are rapidly building a professional force with the education and experience required to make our acquisition managers capable, skilled business professionals with the warfare background necessary to properly manage weapons systems. To keep this program on track, no procurement or acquisition billet may now be filled by other than a Material Professional without a personal waiver from the Secretary of the Navy.

We are now more frequently rewarding program managers and other acquisition personnel who demonstrate superior performance. Acquisition managers are encouraged to maximize communications within the Navy, with OSD and with the other services to eliminate redundancy and to increase quantity buys. This will result in greater competition and lower costs. Managers are also encouraged to be creative and to consider alternate acquisition strategies for unique programs when they feel their approach will be more beneficial to the Navy than those I mentioned earlier.

We must ensure:

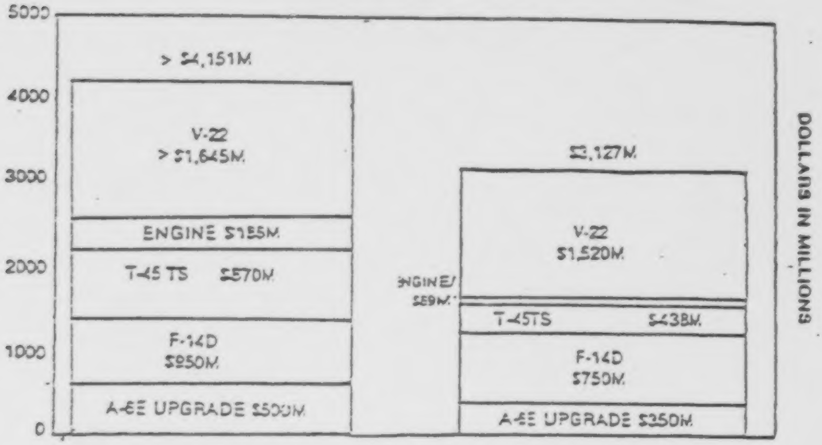
- that cost-capability tradeoffs are examined and that performance requirements that yield only marginal benefits are eliminated;
- that the program's acquisition strategy provides for maximum effective, sustainable competition;
- that the development specifications are tailored to the operational requirement; and
- that the hardware and software development reflects maximum practical commonality.

Fixed-price R&D contracts have resulted in substantial cost avoidance for the Navy. The original price estimates of the V-22, T-45TS, F-14D, and the A-6F upgrade totalled over $4.1 billion. The actual fixed prices for these programs totalled $3.1 billion. Cost avoidance amounted to more than $1 billion.

(U) Let me provide another example of how our new approaches have benefitted the Navy. In a recent case involving a major Navy program, Secretary Lehman stated that he wanted to use a second source and increase competition. The original contractor, upon learning of Secretary Lehman's intentions, gave the Navy a very competitive price in its attempt to keep the contract and prevent the Navy from going second source. The point is that just the threat of competition can keep prices down.

(U) It is interesting to note the difference between the forecasted

DEVELOPMENT COST
(FY 84 DOLLARS)



cost of a program and its actual cost. Consider the CG-47 Program. Analysts predicted that bringing in a second source from FY-1982 thru FY-1985 would cost the Navy $437 million. The actual cost of bringing in a second source over that same period was a savings of $728 million. The overall difference between the predicted and actual costs was $1.1 billion.

When we consider another program, the surface ship Vertical Launch System (VLS), the overall cost savings has been over $250M after just two years of competition. The point is that it is impossible to predict the cost effects of competition. It is clear, however, that second source programs are a good risk. Every Navy program using second sourcing has paid off and resulted in significant cost avoidance.

In summary, our acquisition policy has been recently reviewed and modified and incorporates several changes designed to make the acquisition process more efficient. Greater use of competition, increased contractor investment and earlier use of fixed-price contracts help reduce costs and enhance the production process. The policy benefits all participants in the acquisition process. It encourages investment and modernization on the part of contractors and enhances the quality of products and services provided to the Navy.

### Allied Contributions to Navy R&D

To turn to the benefit we derive from complementary NATO R&D efforts, let me briefly discuss some of our cooperative programs. The Navy has reinvigorated its consultations with NATO armed forces for them to assist in establishing operational and design requirements for new weapon systems. Navy acquisition planners are also required to consider the capabilities of NATO allies to satisfy US requirements before any new development work is begun. In the case of equipment not requiring R&D, naval equipment planners are required to assess the feasibility of filling material requirements by purchasing existing equipment from NATO allies.

Navy competition advocates are also required to consider NATO industrial services for equipment before approving acquisition strategies for new equipment or justifying anything other than open competition. Every acquisition plan now developed by the Navy must have a separate section devoted to NATO armaments cooperation.

These initiatives amplify previous ongoing cooperative efforts such as the NATO Conference of National Armaments Directors as well as other NATO discussion groups, Data Exchange Agreements and Information Exchange projects, the Technical Cooperation Program, and the Foreign Weapons Evaluation Program. Many of the programs I discuss later in my statement testify to our successes in joint development and cooperative programs with NATO and our other allies.

## HIGH OPERATIONAL PAYOFF AT AFFORDABLE COST

In the Gramm-Rudman-Hollings era, it is incumbent upon us to better manage programs so as to reduce costs wherever possible. It is also important to choose carefully those programs where there is a high operational payoff at affordable cost.

Many in the defense community believe that the United States and its allies will never be able to match the Soviet Union's quantitative superiority in weapons. These same individuals feel that our only hope lies in a qualitative superiority achieved by the fullest exploitation of our technological prowess. Taken to the extreme, this concept leads to the development of weapons that are not merely smart, but positively brilliant. In my opinion, such a relentless pursuit of technological sophistication has the danger of making weapons unaffordable. We cannot ignore the increasing sophistication of enemy forces, yet we cannot allow excessive sophistication at exorbitant cost to undermine our ability to procure an array of weapons sufficient in number and type to meet the threat.

In the Navy research and development program, we have resolved this dilemma by dedicating ourselves to two kinds of programs that have a high operational payoff at affordable costs: those that make use of sophisticated, leading edge technology and those that are innovative applications of less sophisticated technology. We have found that sophistication for its own sake buys us very little. On the other hand, intelligently applied technology has reaped significant dividends.

Sophisticated, Leading Edge Technology

The F/A-18 is a good example of the benefits of sophisticated, leading edge technology. The heads-up display and digital presentation of information in the F/A-18 cockpit is an application of sophisticated technology that has revolutionized cockpit design. Both of these features are incorporated in upgrades of all Navy tactical aircraft. They greatly diminish pilot workload and are particularly important in a multi-mission, single seat aircraft.

In addition, the incorporation of built-in test features in the F/A-18 weapon system as well as in most of its avionics simplifies not only the pre-flight check of the aircraft, but also the maintenance of individual components. The aircraft essentially checks itself before flight. For components that fail, their built-in test features allow maintenance personnel to rapidly diagnose the defects causing the failure in order to take corrective action.

All of this has occurred at prices that are steadily moving downward as we get up on the learning curve and stabilize configuration. The flyaway cost of the F/A-18 has decreased 16.9 percent in constant dollars (32 percent in FY 1982 dollars) since its initial production in 1982--and this statistic does not reflect the decreased spare part, test equipment, and personnel requirements resulting from the F/A-18's superior maintenance and reliability record. This example points out the fact that life cycle returns on investment in sophisticated technology are often a better measure of the investment in this technology than is the initial short term yield.

Moreover, it is impossible to quantify the benefit of lessons learned in the F/A-18 that are being applied to our A-6F and F-14D upgrade programs. In addition to incorporating many of the same features in the cockpits of the A-6F and F-14D that were so successfully introduced in the F/A-18, we have also incorporated many of the same avionics in these aircraft. The gains in commonality are impressive. Over fifty electronic units on the A-6F have part numbers identical with either the F-14D or the

F/A-18. Twenty-nine of these units are identical on all three aircraft models. Common items include mission computers, navigation sensors, displays and communications equipment.

Another example of advanced technology yielding splendid results is the AEGIS weapons system. The recently deployed AEGIS system integrates advanced weapons components to create a superior system for AAW warfare battle management. The AEGIS system is a prime example where the increased upfront cost of incorporating advanced technology reduces the total life cycle cost and provides increases in the effectiveness of the battlegroup. The subsequent life cycle cost reductions resulting from manning reductions, increased reliability, reduced spare parts costs and reduced maintenance are equally impressive.

This past year we completed the necessary testing of the second generation AEGIS SPY-1B radar. It has improved performance as compared to the SPY-1A, which is installed on earlier AEGIS cruisers, against high-altitude, high-speed targets. Full production has been approved for this radar to support installation on CG's 59 through 73.

We are actively pursuing second sourcing the AEGIS integration effort and the six hardware subsystems (director, FCS transmitter, 400 Hz convertor, SPY transmitter, SPY antenna and signal processor) that constitute the AEGIS radar weapon system. With the exception of the signal processor, all hardware subsystem second sourced contractors will be selected in FY 1986. Annual procurements will be on a competitive basis after each of the hardware second source suppliers have been selected.

Total up front cost benefit to the Navy based on the advanced technology of the SPY-1B upgrade coupled with hardware and weapon system integration competition will provide a most cost effective AAW system. Because the combat systems employed in the AEGIS cruiser and the new AEGIS destroyer are basically the same, cost benefits can also be expected from the large number of common systems used in the existing CG-47 and forthcoming DDG 51 class ships.

## Innovative Applications of Less Sophisticated Technology

Let me now turn to innovative applications of less sophisticated technology. One of the best examples showing that high pay off solutions need not be complex, expensive, or sophisticated is the Low Cost Sonobuoy (LCS). The LCS is an inexpensive and innovative solution to our dual problems of decreasing Soviet noise levels and increasing numbers of Soviet submarine deployments.

LCS had to be inexpensive so that it could be used in sufficient quantities to be effective. Its design results in decreased unit cost and simplified requirements allow less expensive sonobuoy packaging and fabrication. An operational advantage is realized in increased area coverage since the aircraft is no longer limited by its sonobuoy receiver channels. The aircraft can monitor hundreds of LCS's under reduced operator and avionics workload. The LCS is a simple solution to a complex problem with potentially profound results.

Another example of a smart, simple solution is our acquisition of remotely piloted vehicles (RPVs), program which is also noteworthy for its extremely streamlined, responsive acquisition strategy.

Our interest in RPVs is a direct result of the 1982 and 1983 Israeli incursions into Lebanon, during which RPVs yielded excellent results. As such, this program is a good example of our eagerness to assimilate lessons learned - even from our allies' operations.

We are using a unique two-step acquisition strategy to rapidly field RPV systems at a minimum cost. Instead of the standard development approach, which can take several years to field a new capability in the fleet, we are accepting the performance of off-the-shelf RPV systems that meet the fleet's urgent need. Industry was asked to rapidly provide, at minimum cost to the Navy, their systems for Navy competitive testing. The selected systems will be used by the fleet immediately to develop tactics, determine the quantities we need, and analyze the capabilities required in any follow-on development. It may turn out that the initial off-the-shelf systems are adequate for the long term requirement except for improvements or additions to the sensor packages. This concept has given us a fly-before-you-buy approach which is always desirable when affordable.

THE NET ASSESSMENT

What has been the net effect of the measures we have taken to inject better management into our R&D programs and to increase funding when there is a high operational payoff at affordable cost?

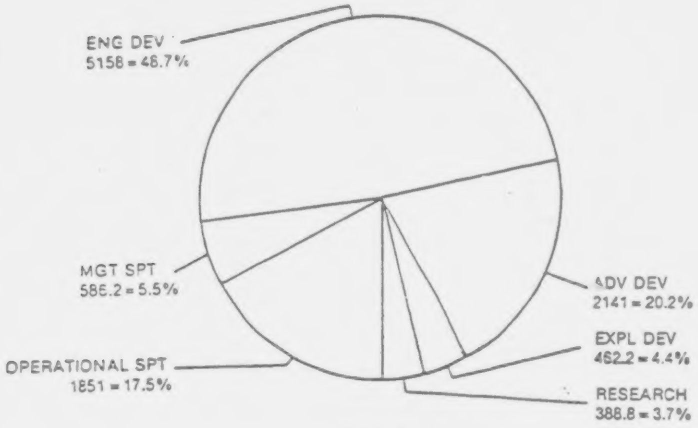
To begin with, our request for $10.6 billion is a $700 million reduction from our FY 1986 request, and while our RDT&E request for FY 1986 was 10.8 percent of the Navy's Total Obligational Authority (TOA), this year it has been reduced to 10.2 percent of the Navy's TOA.

Money is spent for three major activities: the Technology Base (basic research and exploratory development), Development (advanced development, engineering development, and operational support), and Management Support. The Technology Base is 8.1 percent of the overall R&D program. It provides fundamental knowledge and new technologies that find a wide range of applications and generate concepts for new systems. The largest share of resources, 86.4 percent, is devoted to the development of platforms and weapon systems. The remaining 5.5 percent is used to pay for management support in the operation and maintenance of R&D ships and aircraft, test ranges, laboratories, facilities, and other areas necessary to support our RDT&E programs.

The following chart illustrates these statistics.

*NAVY RDT&E*

FY 1987 BUDGET REQUEST = $10,586.8



RDT&E,N
CATEGORY

The allocation of funds over these three areas is roughly proportionate to our allocations last year, but the actual dollars allocated to each activity have been reduced -- a tribute to the better management of our R&D programs.

Finally, our commitment to increase funding only in those programs where there is a high operational payoff is obvious in the steady decline in the total number of Navy R&D programs in the last five years. The following table shows this scorecard.

NUMBER OF NAVY R&D PROGRAMS

| FY 83 | FY 84 | FY 85 | FY 86 | FY 87 |
|---|---|---|---|---|
| 532 | 507 | 421 | 415 | 395 |

We are particularly proud that we have accomplished this reduction in the number of Navy R&D programs while still fostering the dynamic, responsive research base that is so essential to the development of creative solutions to real threats.

## THE TECHNOLOGY BASE

An adequate research and exploratory development base underlies all high payoff systems. A dynamic, fertile research and development base is one of our most potent weapons in this age of violent peace. To support our research and technology endeavors, the Office of the Chief of Naval Research (OCNR) sponsors a broad based research (6.1) and exploratory development (6.2) program which provides the foundation for future technology options. Technological solutions impacting fleet systems today are available because of prior investment in this technology base.

## THE OFFICE OF NAVAL RESEARCH (ONR)

The ONR program will include accelerated efforts on remote ocean sensing and related data assimilation, ocean modeling and field measurement programs. Precise knowledge of oceanographic conditions and their effects on sensors and weapons forms the underpinning of future advances in surface and anti-submarine warfare. Synthetic aperture radar systems have already identified important ocean patterns that cannot be discerned by direct surface measurement. Advanced instruments and synthetic aperture radar systems will be used to provide a synoptic view of the ocean as well as a focused view of ship wakes and other fine scale structures. Such approaches promise to revolutionize remote sensing for optical observations and systems integration at the very low light levels. Recent ONR support of the discovery of the Titanic represented a dramatic demonstration of emerging capability in this area.

Last year the Secretary of the Navy, as part of an effort to revitalize Oceanography directed the following initiatives: the establishment of the Institute of Naval Oceanography; an expansion of graduate fellowships in ocean sciences; an increase in the number of academic chairs in oceanography; and the strengthening of the ocean sciences research and exploratory development program. Each of these goals has been met. The Institute for Naval Oceanography was established on the first of October 1985 in Bay St. Louis, Mississippi. Additional graduate fellowships and chairs of oceanography have been established. The technology base was refocused and increased. As a result, the FY 1987 commitment is also budgeted to increase by aproximately six percent.

Major-thrusts will continue in submicron electronics, biotechnology, hydrodynamics and drag reduction. Extensive programs in materials research, including light-weight, tough and inexpensive composites have been revitalized with focused initiatives. Comparable thrusts are planned across the spectrum of ONR's broad program covering Navy relevant research in the physical, engineering, environmental and life sciences.

In clear testimony to the quality of Navy research programs, the 1985 Nobel Prize for Chemistry was awarded to Dr. Jerome Karle of NRL, for his far-ranging work in developing direct methods for the determination of crystal structures.

In FY 1986 ONR established a new program element, the University Research Initiative (URI), to address constraints on the ability of U.S. universities to perform basic research and to train the nation's future scientists and engineers. Funds for the Navy URI will be doubled in FY 1987. Strong emphasis will be placed on initiatives that encourage University/Naval laboratory interactions.

THE OFFICE OF NAVAL TECHNOLOGY (ONT)

The Navy has restructured its 6.2 program and reorganized its manangment. Program elements (PEs) have been reduced from 21 to 14 and now correspond to mission areas; program objectives now respond to the war fighting objectives of the Navy's Maritime Strategy; and ONT now provides direct block funding to performers, thereby eliminating a large management layer, and reducing the number of administrators from hundreds to a few dozen.

A major share of ONT's 6.2 investment is aimed at countering the rapidly expanding undersea threat. For example, we are accelerating final development phases of a new warhead--corner-stone of the MK-50 torpedo $P^3I$ program, in order to provide the lethality needed to deal with the new Soviet submarines; pursuing jointly with DARPA advanced concepts such as advanced warheads; and initiating a joint program with the Department of Energy for development of the next generation undersea weapons.

Technologies are being developed to meet the increasing effectiveness, sophistication and proliferation of threats to AAW/ASUW/STRIKE operations, including technologies for stand-off weaponry and for a family of improved target acquisition sensors. Multiple-target warhead and fuze technologies will reduce costly inventories and cost per kill.

EW, $CC^3I$ and $C^3I$ technologies are being developed to counter the proliferation of sophisticated threats and the severe jamming environment which are expanding operations into new regions of the electromagnetic spectrum.

## THE ADVANCED TECHNOLOGY DEMONSTRATION PROGRAM

To promote the transition of technologies from tech base programs to Navy systems, I have established the Advanced Technology Demonstration (ATD) program in FY 1987. It is of major significance to the Navy's technology base in that a technology, if successfully demonstrated, would have a transition window to a development program. The intended effect is to demonstrate the feasibility of technologies that are less mature or more risky than an individual program manager would be able to support.

The FY 1987 program contains the following projects:

- o an ultra-low loss fiber optics demonstration project which will, if successful, allow major performance improvements and cost reductions in advanced Navy systems;
- o a fiber optic missile guidance demonstration;
- o an undersea weapons technology demonstration of quiet energy sources and propulsion concepts that could offer a major reduction in torpedo radiated noise levels; and
- o a conventional munitions technology program designed to demonstrate new missile warhead and fuze options to defeat future air targets.

In the aggregate, the ATD program is designed to identify and exploit emerging technologies and to accelerate their introduction into fleet systems.

## TEST AND EVALUATION

All Navy systems undergo thorough testing by the Navy to assure that they will function as required at the appropriate time. Last year the achievements of Navy's independent test and evaluation agency, the Operational Test and Evaluation Force were presented. We are continuing to build on an enviable reputation by instituting innovative ways to test high reliability equipment with extraordinarily long mean-time-between-failure rates permitted by emerging technology. Such steps will continue to ensure that new, warranted equipment like the Carrier Aircraft Inertial Navigation System (CAINS) II can be adequately tested without spending the time required to ensure it meets required failure criteria. Getting a proven product to the fleet as rapidly as possible remains our goal.

The Navy test and evaluation ranges and facilities continue to provide the wide range of services required for the proper support of test and evaluation. Our Improvement and Modernization (I&M) program continues to be planned and funded to ensure these facilities will continue to meet the test resource requirements of future weapon systems.

At all the ranges, a major facet of the I&M program is the OPSEC secure communications program. We have initiated a program to enhance our ability to protect weapons systems test and performance data. One phase of this affordable and comprehensive program provides for the encryption of data and telemetry and prevents the enemy from collecting the data that would allow easy and cheap replication or low-cost production of effective countermeasures.

The Department of Defense Director of Operational Test and Evaluation (OT&E) also plays a very important role in supporting our own test and evaluation program. Two Memoranda of Agreement detail procedures for approval of Navy test plans by the Director of OT&E and the participation of personnel assigned to the Director of OT&E in Navy operational tests. We are working closely with them and welcome their participation in our programs.

## MATCHING R&D PROGRAMS TO THE MARITIME STRATEGY

The Navy's maritime strategy sets the basic direction for our R&D efforts. Execution of this strategy against the Soviet Fleet's bastions, defending Norway and supporting NATO and our Pacific and other Allies has shown the need for increased capabilities in ASW, stand-off and anti-radiation weapons, aircraft and ship survivability, command and control and amphibious assault. The Navy's support of national policies toward the third world, low intensity conflicts, anti-terrorism and other crisis response requires increased capabilities in special warfare, remotely piloted vehicles, low cost accurate gunfire support, surveillance and intelligence. We are striving for commonality in these areas with the other services and our Allies for both force multiplication and cost reduction.

## KNOWING THE THREAT

Many challenges and imponderables confront us as we try to match our research and development initiatives with the requirements of our maritime strategy. Since the threat is constantly evolving, our R&D initiatives must respond to short term and longer term changes in the threat. At the same time, we should endeavor to use our R&D efforts to make systems presently deployed as effective as possible. This means that at any given time, we are applying R&D to developing and evaluating new fleet and platform level tactics to counter the present threat and we are launching efforts to contend with the future threat we predict. These challenges are not insurmountable because of the nature of fleet operations which allow us to operate against the enemy day in and day out. It is in this way that we know the threat intimately, and derive from this knowledge what our maritime strategy and supporting tactics must be.

THE PRESENT THREAT

Our battlegroups observe the operations of Soviet task forces, including Kiev-class carriers. Our aviators make regular contact with Soviet aircraft. From these encounters we gain valuable intelligence on Soviet electronics and avionics systems--radars, jammers, electronic warfare receivers.

Fleet exercises and wargaming are important adjuncts to these operational inputs in that they allow us to develop tactics to counter the threat and also point up our own vulnerabilities. In 1985, the Navy conducted 86 major exercises, involving 55 allied countries. In these and many other ways, our day-to-day operations at sea and in situation rooms give direction to our R&D efforts.

PREDICTING THE FUTURE THREAT

What about predicting the future threat? Not only must our R&D effort strive to counter any present threat, it must try to anticipate new threats before they are revealed to us. If we are not successful, our fielded responses to new threats will always be 10-15 years behind. In no other area is this more evident than in the field of electronic warfare where the parametric data--not merely functional capability--is required to counter the threat. This effort is additionally complicated by the fact that many of the electronic threat systems deployed only reveal their operating parameters when used in a very controlled environment. To counter these "undefined or unexploited threats," we must embark on R&D efforts which result in systems that are responsive to projected or technically feasible threats.

A great emphasis is placed on all of our intelligence assets to obtain the most accurate data and projections as to where the threat is evolving. Additionally, the intelligence community provides feedback as to "fixes" which are being incorporated in threat systems. These efforts are complemented by examining the evolutionary trends of US and allied systems and crosspollenizing our ECCM and ECM communities so that lessons learned can be exchanged, recorded, and implemented into our systems.

Because of the ever-changing nature of the threat, our R&D efforts must result in systems that are versatile and adaptable. Software-controlled modularized systems that can be built upon allow us to change our systems as the threat changes. Modularized systems also allow us to incorporate contingency modules in existing systems to respond to a changed threat.

The major outcome of such R&D efforts is the development of systems that are not only effective against known threats but have generic capability against families of threats. While the dynamic and multi-faceted character of a predictive vice reactive approach to R&D could give the impression that the Navy was spending too much on R&D and not fielding many systems, without this approach, we would only field systems to counter a decade-old threat.

As I have tried to illustrate, it is our knowledge of the threat that underlies our Maritime Strategy. Fortunately, this knowledge also gives us the information on which to base R&D efforts that correspond to the threat and, therefore, support our Maritime Strategy.

## MOBILIZING AMERICA'S INDUSTRIAL CAPABILITY

Over the past year, the Navy has made important headway in two programs involving this country's industrial capability. These programs are the Wartime Surge Study on which we have important results to report, and the Rapid Acquisition of Manufactured Parts (RAMP) program — which is equally impressive.

## WARTIME PRODUCTION SURGE

The Navy, like the other services, is faced with the problem of the need, if war threatens, for a high number of expendable ordnance. We must have a realistic plan to mobilize our industrial capability to surge and produce those expendables in large quantities and quickly. Until recently such planning was based upon stereotyped studies without motivated, innovative dialogue between industry and the service. Using this new dialogue approach the Navy has sponsored three studies on the MK-46 torpedo, the AIM-9M Sidewinder, and the Sparrow missile. We have dramatic results to report on the MK-46 torpedo and the AIM-9M Sidewinder. The Sparrow study is underway.

The Navy felt that industrial prime contractors and their major subcontractors did not have an adequate appreciation of the environment likely to accompany a war threat. We often forget that there are few left in the workforce or in the service who remember the stunning civilian and military mobilization efforts of 1941 and 1950. Therein lies a key factor -- some education is required to convince our industrial colleagues that in an environment which threatens our society there will be no priority for production of creature comfort consumer items. Once this scenario was understood, I am proud to say we found that our production engineers were as creative and innovative as their grandparents were -- in some cases more so.

The study team asked the producers of the MK-46 two questions: how much investment would be needed in peacetime to increase torpedo production ten-fold in wartime and how quickly could the contractor reach wartime production goals?

Initially, Honeywell, the prime contractor for the MK-46, had estimated that a $22.3 million peacetime investment was needed, mainly for additional production and test equipment. This figure was lowered to $6.9 million when the contractor acknowledged that if certain testing procedures were relaxed, such as those to ensure long shelf life, cosmetic standards and double-checks, then the additional test equipment was not critical.

Where previous estimates required 24 months to increase production ten fold we arrived at a contractor-Navy consensus that we could increase production of the MK-46 from 80 to 800 units in two to three months.

Why is there such a difference in the estimates? Using current peacetime procedures, it would take 24 months to expand. In wartime, the plants would be operated around the clock, the labor force would be shifted from commercial products, and a specification which reduces the 20 year shelf life would be imposed. At Honeywell, these production workers require only two weeks of retraining. Also, as production expands, efficiencies can be realized. Now, many machines stand idle as workers move from one machine to another. In wartime, each station would be manned and work could proceed continuously.

Honeywell's subcontractors showed similar gains once the mobilization environment was defined. They can divert labor from commercial production and can train labor quickly.

For AIM-9M Sidewinder, the wartime production goal is three times current production. Previous mobilization studies had shown 18 months lead time and an investment of 23 million dollars would be required to meet our wartime goal. Our studies showed these time and resources estimates overly conservative and when we applied the MK-46 study principles to Sidewinder, production ramp up time fell dramatically to five months. Further analysis allowed us to lower our lead time to four months. We believe the investment required to meet these lead times is more in the range of 18 million dollars and studies continue to refine this figure.

The third study on Sparrow had just begun. The Navy is examining the Sparrow AIM/RIM-7M Guidance and Control Section (GCS). Raytheon is the prime contractor. The Navy would like to increase production by almost fourfold during war. We believe we can do it.

I believe you will agree these are startling and gratifying results. I have hence learned some valuable lessons:

- o we need a wartime production specification for these expendables which is based upon much less shelf life and much less in-process testing;
- o we need in place legislation which relaxes specific regulations during a national emergency;
- o most firms now producing expendables can expand assembly capabilities at modest cost; and
- o our industrial engineers are creative and innovative on surge once they understand the problem.

There are also some lessons which require some further study and thought. For example, the electronics assembly for the MK-46 torpedo is done off-shore due to cheaper labor costs. Production surge planning will require us to stockpile a large number of these assemblies or fund a reinstatement of this production capability. We have found in all three studies that the electronics industry is our weakest link in the mobilization environment as that industry must go offshore on labor intense assembly to keep costs down.

But the Navy is doing more than studying these issues. We cannot wait for the immediate threat of war to verify our studies. This year we will produce torpedoes using modified procedures. The goal is to see how well these torpedoes perform when some process and specification tests are waived. In addition, the Navy has put money into the FY 1987 budget to cut the time it takes to expand in wartime. The Navy has $18 million planned for Sidewinder surge, $11 million for Harpoon, and $23 million for sonobuoys. The Navy will continue to examine ways to increase wartime surge capabilities. Our knowledge of the mobilization environment has advanced considerably in the last year, and we expect it to advance even more in the coming year.

## RAPID ACQUISITION OF MANUFACTURED PARTS (RAMP) PROGRAM

A major factor in maintaining and repairing the ever increasing variety of systems and equipment used by us is the availability and timely acquisition of parts. This is a serious problem, particularly for parts that are no longer being manufactured, for which no specifications exist, and that are only needed in limited quantities. One of our recently initiated projects addresses this issue. It features a team of industrial firms working closely with universities, other Federal agencies, and Department of Navy organizations under the coordination of a State organization. We call it RAMP -- the Rapid Acquisition of Manufactured Parts program.

RAMP's objectives are to: (a) integrate advanced computer integrated manufacturing into the Navy logistics system; (b) to establish procedures and a capability to communicate our parts requirements and specifications to automated or flexible manufacturing facilities; and (c) to install prototype flexible manufacturing units in Navy industrial activities. RAMP will shorten the time required to obtain parts -- we expect reductions down to as little as one-fifth of the time currently required for some parts. This will in turn reduce our inventory investment cost. Technologically speaking, it will improve manufacturing techniques and in-process quality control. The focus is initially on small mechanical parts and will include printed wiring assemblies or circuit boards in the near future.

RAMP is being carried out by a consortium of industrial, academic and government organizations, organized by the South Carolina Research Authority. Funding is on a cost sharing basis with the Consortium picking up about a third of the $90M costs projected over five years.

## R&D PROGRAMS IN THE NAVY MISSION AREAS

Now let me discuss our mission areas. We have found that systems dedicated to a single mission are increasingly unaffordable. Therefore, we are developing systems that are dual role or even multimission. We are also trying to find innovative ways to apply technology developed for one mission area to other areas and weapon systems.

In cases where a weapon system performs missions in more than one area, it will be discussed in its primary mission area. I will discuss programs in the following mission areas: electronic warfare, strategic programs, anti-submarine/mine warfare, anti-surface/strike warfare, anti-air warfare and amphibious operations. In each program I cover, I will show some of the ways we have responded to your scrutiny of our programs with better ways of doing the Navy's business.

ELECTRONIC WARFARE

The Navy's goal in Electronic Warfare (EW), is to deceive, deny, disrupt and exploit the enemy's electronic emissions. The threat that the Navy has to counter has proliferated across the entire electromagnetic spectrum from low-frequency surveillance radars through radio-frequency guided missiles, infrared homing missiles, optical, and laser-directed threats and beyond. These threats are integrated through an external command and control network. To counter this threat, the Navy strategy for EW addresses all phases of an engagement providing both offensive and defensive capability to the fleet.

In the surveillance phase, systems under development such as the Battle Group Passive Horizon Extension System (BGPHES) will provide increased surveillance capabilities.
Through information provided by BGPHES, EP-3E updates in the future, RPV's and other assets, we can use our newly developed devices which will result in depletion of threat assets, delayed action and confusion which could potentially cause an adversary to reconsider the advisability of a hostile action.

When an engagement has proceeded into a targeting phase, active support EW systems such as the recently deployed EA-6B ICAP II and the improved and increased number of SLQ-32's will provide target screening and false targets which will delay hostile weapons systems' targeting solutions until the hostile platform is within our weapons range or potentially cause the expenditure of weapons on false targets. On the offensive side, the ongoing effort to marry the offensive capability of the HARM missile system with the electronic warfare capability of the EA-6B aircraft will provide a capability to selectively target desired high-value targets. BGPHES and other assets will provide extended targeting information which when integrated into the offensive capability of the Battle Group will provide an extended range for the intelligent uses of weapons.

In the terminal phase, our self-protective EW suites such as the recently deployed ALR-67/ALQ-126B on the F/A-18, the SLQ-32, the ALQ-162 missile jamming system (which was just approved for production), and our family of air-launched and ship-launched infrared and radio-frequency decoys should improve survivability and increase the warfighting capability of our tactical assets. In general, the Navy is developing its EW suites in an integrated package consisting of warning receivers, active onboard jammers and offboard decoys instead of independent systems. These suites are complemented by dedicated EW support systems like the EA-6B and BGPHES. This approach provides complementary operation of systems by design vice complex after-the-fact tradeoffs to permit simultaneous operations.

The keynote of Navy's terminal phase EW strategy is commonality. The Navy is developing its electronic warfare capability with an emphasis on eliminating any efforts which are redundant with the US Army or Air Force. To this end, we are examining all our EW programs and requirements while conferring with the other Services to structure a total EW program which is nonduplicative, affordable and interoperable. Our recent cancelling of Navy JTIDS and the restructuring of the program in line with the Air Force JTIDS is an example of our commitment to commonality.

The initiatives of the 1985 DOD EW Plan are being used as a departure vehicle for these joint efforts. It is Navy policy that EW systems for small helicopters be developed by the US Army and be procured as additions to Army requirements. This effort results in almost total commonality between USMC and US Army small helicopters. Jointly with the Air Force we are concluding the Full-Scale Development for the ALQ-165 system and are beginning development of the Integrated EW System (INEWS) for the next-generation advanced technology aircraft. In radar-warning receivers for tactical aircraft, we are providing Navy inputs to the Air Force ALR-74/ALR-56M program in order to achieve commonality in future upgrade programs where cost effective for both Services.

In addition to our joint effort with other Services, we are actively pursuing joint decoy developments with countries like Australia, the United Kingdom and others to reduce our research and development costs and to ensure commonality with our allies. In the effort we are pursuing with Australia we are breaking new ground. This is a truly cooperative R&D effort. We plan to develop the electronics payload and the Australians will develop the flight vehicle. We will jointly integrate these two components of the system.

In order to coordinate our EW assets, we are developing systems like the EW Coordination Module (EWCM) and the EW Control System (EWCS) which provide Battle Group and platform integration of the EW assets, reducing duplication of responses and aiding in the evaluation of the effectiveness of EW actions.

In addition, we are developing improved ranges and simulators to provide realistic mixed force threat scenarios so that an operator can exercise not only in a dense threat environment but in one which contains representative jamming of his sensors. This training is mandatory to allow the operators to develop tactics which optimize offensive capability in a hostile jamming environment and increase awareness of the defensive advantage provided by our own coordinated EW systems.

The Navy EW acquistion policy is one of cost control and competition. We have restructured ongoing production programs such as the SLQ-32 and the ALR-67 to bring on a second vendor to reduce cost. The next version of the EA-6B, called Advanced Capability (ADVCAP) is being developed under a capped R&D contract which contains three years of production options. In the Active Electronic Buoy (AEB), we are competing at the limited production phase and we will maintain competition in all later production phases.

STRATEGIC PROGRAMS

This past year was the twenty-fifth anniversary of our Fleet Ballistic Missile (FBM) force. During this period the FBM force has been on 2,379 deterrent patrols. To meet the changing threat the force has been progressively modernized from Polaris to Poseidon to TRIDENT I.

TRIDENT

The Navy has accepted seven TRIDENT SSBN's, five of which are operational conducting deterrent patrols carrying the TRIDENT I Missile. There are thirty Poseidon SSBN's, twelve of which carry the TRIDENT I Missile.

In the last few years the Soviets have increasingly hardened installations which protect their leadership and warfighting installations. To counter an ever increasingly hardened target requires weapon accuracy as well as an adequate explosive force. To achieve the appropriate balance between these two parameters we initiated an accuracy improvement program in the mid-seventies. This program looked at all of the parameters which add to system inaccuracy and needed improvement if a mobile system was ever going to be able to engage targets that had been hardened. The results of this study were the basis for the TRIDENT II program which now has entered into the third year of engineering development. The TRIDENT II program has the accuracy and yield to engage this broad spectrum of targets.

Because of the increased explosive arc of the TRIDENT II rocket motor, we had to build a new launch complex at the Eastern Test Range. The work on this complex has progressed very well and is on schedule for the first launch in 1987. The facility at Kings Bay is also progressing very well to support the IOC.

There has been a substantial activity on subsystem tests during the past year. These tests include all three stages of the rocket motor, the launcher, the navigation and guidance systems and many others. I cannot say that all tests were successful on the first try but, on balance, I would say we are doing all right and are on schedule. One item that is of concern, and over which we do not have control, is the continuing slippage of the availability of the Global Positioning System receivers. In order to meet our testing requirements and the initial deployment we have had to come up with a work around interim solution.

As we reported previously, the first TRIDENT II weapon system will go onto the ninth TRIDENT submarine. The introduction of the TRIDENT II weapon system onto the ninth TRIDENT submarine has been and remains a challenge since she was to be a TRIDENT I ship and construction had begun before the start of the TRIDENT II program. I am happy to say that to date we have met all of the scheduled weapon system component deliveries as well as all relevant interface design information requirements.

## Strategic Communications

The maintenance of connectivity with our SSBN force has been absolutely essential to the success of the strategic forces. One significant improvement in this area has been the completion of the Extremely Low Frequency (ELF) transmission system in Wisconsin. The first phase of the ELF system is currently undergoing operational testing and is expected to become operational in late FY 1986. A second transmitting site, which will complete the ELF system, is being constructed in Michigan and is expected to complete operational testing in the fall of 1987.

The planned replacement for the EC 130 TACAMO airframe, the E6A, is progressing well. Fabrication of the prototype aircraft commenced in FY 1985. Procurement authority of the first two production aircraft will start in FY 1986. The communications suite will come from the EC 130 TACAMO aircraft. A fleet of 15 E6A's is planned.

## TOMAHAWK

To both increase our deterrence and our conventional strike capability we have now deployed the TOMAHAWK weapon system on eight surface ships and fourteen submarines. This year was the first year of competitive procurement of TOMAHAWK. During the past year we have also completed the Operational Evaluation and authorized production of the conventional variant of the TOMAHAWK system. The submunition dispenser variant is currently undergoing developmental testing and will enter OPEVAL in FY 1987.

Based on a successful TECHEVAL and to meet the requirements for the OPEVAL and eventual deployment on the first two 688 Class submarines with the Vertical Launching System, limited production of the launchers has begun. Vertical launch deployment tests have been performed from our underwater ship simulator for submarine launch tests and from the USS NORTON SOUND for surface ship launch tests.

The two major efforts which we are currently pursuing are to improve the shipboard weapon system software to reduce the eventual maintenance cost and to reduce the time required to plan a mission of this missile.

## Strategic Defense Initiative (SDI)

The Navy fully supports the President's Strategic Defense Initiative. We are providing support, through our laboratories, in basic technology research. The majority of the Navy work has been in support of directed energy technology, the largest single effort being an outgrowth of the Navy's High Energy Laser (HEL) Program. This joint service effort under Navy program management uses the most powerful research laser in the free world. The program is in the forefront of solving a wide range of generic technical problems relevant to HEL systems, and is particularly important to the development of the optical train and beam director portions of the SDI Office's Free Electronic Laser Program.

The Navy is also making important contributions in the area of SDI Battle-Management(BM)/C$^3$. Our contributions to SDI's BM/C$^3$ research is a natural extension of Navy research in this area for multi-layered defenses of carrier battle groups.

## ANTI-SUBMARINE/MINE WARFARE

The ASW and Mine Warfare R&D programs directly support the basic ASW warfighting strategy which remains unchanged. We continue to rely on a layered offensive strategy designed to maximize enemy submarine attrition and assure a high level of protection for our strike and reenforcement/resupply forces. The first layer is forward area and barrier long-term offensive operations involving SSN, VP and long-range or area surveillance systems. Subsequent layers form defensive screens around naval task forces, employing SSNs, surface ship advanced ASW systems, helicopters and carrier-based fixed-wing aircraft.

The attack submarine has for many years been preeminent in the Soviet fleet force structure. The larger size of the Soviet submarine force has long been a problem that we have effectively countered by application of superior technologies.

During FY 1985 we formulated a Master ASW R&D Strategy and identified key technology areas for maintaining our ASW advantage. The investment strategy for translating these technologies into our ASW systems is being developed and operational requirements are being documented. The high payoff technology areas which can be readily implemented in the near term have been given special focus as Urgent ASW Initiatives. This ASW thrust is reflected throughout the budget in such areas as low frequency active surveillance system development, broadband acoustic data processing, active sonar classification, and efforts where technology development strategies are being prepared.

We are also emphasizing commonality initiatives in the ASW mission area such as the Enhanced Modular Signal Processor (EMSP) program which continues to progress on schedule. It completed a Preliminary Design Review and System Level Critical Design Review in FY 1985. It has a breadboard system in operation and will commence fabrication of the Engineering Development Models this fiscal year. We are pursuing a VHSIC technology insertion program for the arithmetic processor which will be included in the production EMSP's. The EMSP will be used in a wide range of ASW systems, including the P-3 Update IV, FY89 Submarine Combat System, SURTASS Upgrade, Fixed Distribution System, SQQ-89 Upgrade, and the CV helicopter Advanced Lightweight Sonar System.

ASW Surveillance Systems

The Phase II Sound Surveillance System (SOSUS) backfit program has been completed, and we are preparing to implement improvements, such as inter-array processing, adaptive beamforming, integrated acoustic displays, and wide-band acoustic recall.

The first Surveillance Towed Array Sensor System (SURTASS) ship was deployed in FY 1985, and there are now 7 ships operational, all of which are achieving outstanding results. We are now attempting to accelerate development of the Small Waterplane Area Twin Hull (SWATH) platform for the SURTASS mission, and intend to award a contract in FY 1987 to upgrade the SURTASS system.

Technology advancements in low cost, low power, small diameter fiber optic cables that can efficiently transmit data at very high rates, combined with our ability to process and manage increasingly greater quantities of data with high speed computers and computer assisted operator aids, are making this approach a more effective method.

We have deployed a test bed for evaluating the Fixed Distributed System concept and are achieving exceptional results. In FY 1986, its capability is being expanded and if the results continue their encouraging trend, a Milestone II decision will be made in FY 1988.

In the ARIADNE program, we have demonstrated the technologies required to deploy a self-powered fiber-optic system from fixed-wing aircraft, helicopters and surface ships. We are now preparing for an advanced technology demonstration which is scheduled to culminate in a large-scale system evaluation in FY 1989.

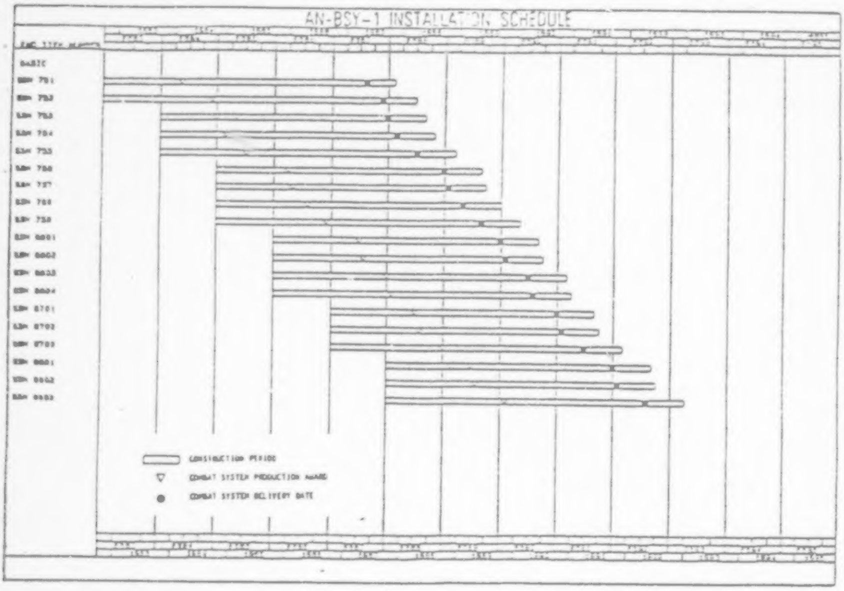
### Attack Submarine Programs

SUBACS Let me begin by discussing the Submarine Advanced Combat System (SUBACS). This system was to be incorporated in the present SSN-688 Class submarines, but its technology was also to be used for the SSN-21 combat suite, which we have designated the FY89 Submarine Combat System.

SUBACS Basic was necessary to give SSN 688 Class submarines the capability to meet the growing Soviet threat. SUBACS adds a robust system and increased passive sonar performance against Soviet submarines. Space and weight savings of SUBACS allow SSN 751 and follow-on ships added buoyancy. Without the capabilities added by SUBACS Basic, our SSNs would not be able to meet the improving enemy threat.

The SUBACS program encountered significant technical problems with fiber-optics data bus performance and with ceramic circuit-board manufacturing processes. A combination of previously unfunded requirements, cost overruns in the Full-Scale Engineering and Development contract, and increased production cost of certain components resulted in a financially unexecutable program with excessive schedule risk.

In view of these problems, we carefully evaluated the potential impacts of either program cancellation or stretchout. Cancellation was considered as an option which might be necessitated by continued inability of the prime contractor to control costs or by Congressional withdrawal of necessary funding support. Stretchout was considered primarily to provide additional development time if it became apparent that adequate capability could not be provided in time to support ship delivery schedules; revision of ship delivery dates would also have been required. The costs, both in dollars and in delayed warfighting capabilities, would have been very large for either of these options. Fortunately, continued Congressional support and successful contract renegotiation allowed us to avoid being forced to choose either option.



This chart provides an appreciation for the impact which delay or cancellation of SUBACS would have had on our 688 Class attack submarine shipbuilding program. We currently have nine SUBACS-equipped ships under fixed-price contracts with Fiscal Year 1983 through 1985 funds. Those ships are scheduled to deliver at an average interval of approximately three months. We concluded that each $10 million of FY-1986 funding not provided would delay equipment delivery to the shipbuilder by one month, with an equal delay in the SSN 751 delivery date. Because of shipyard workload and scheduling considerations, delays greater than two months would necessarily delay the following ship and a ripple effect would probably occur deeper in the schedule. Cancellation of the program would have delayed SSN 751 for at least a year for procurement of an alternative system and necessary major rework of associated shipboard systems and structures. The ripple effect from that delay would have been extremely costly to both the shipbuilders and the government, and we would undoubtedly have found ourselves responding to claims for damages.

The program has now been restructured into two separate programs -- The AN/BSY-1 and the FY89 Submarine Combat System.

*AN/BSY-1* The AN/BSY-1 is the combat system intended for FY 1983-1988 SSN 688 Class submarines. The fiber-optic bus has been replaced with low risk Navy standard UYK-43 computers for interconnection of functions. Substantial use is being made of existing software and software currently being developed by other programs. The significant warfighting improvements expected from the original SUBACS Basic system have all been maintained. The contract has been renegotiated to impose cost ceilings and penalties for performance and schedule shortfalls as directed by the Congress. Competition has been enhanced by bringing aboard a follower contractor. As presently structured, we now have an executable program that will meet the shipbuilding schedule.

*FY 89 Submarine Combat System* The FY89 Submarine Combat System replaces the former "SUBACS B" (the ultimate SUBACS configuration) for SSN-21. We are also evaluating an option to put it on the FY 1989 SSN 688 Class submarines. In the FY89 Submarine Combat System, competition has been greatly increased by contracting for parallel two-year System Design Definition efforts. The principal emphasis will be on improved performance and operability enhancement achieved through software development. These initiatives have generated great interest within the business community. It is clear that the Navy will benefit from competition and innovation. We are confident that we will meet or exceed all requirements previously imposed on "SUBACS B".

*SSN-21* The SSN-21 preliminary design effort has been completed. Competitive contract design efforts are presently in progress at both submarine shipyards, due for completion this summer. The preliminary design effort accomplished a number of things. Technical risk has been reduced through analysis of design tradeoffs, cost estimates have been validated, and the bow arrangement has been revised, yielding greatly improved sonar capabilities. The bow design is now compatible with the Advanced Conformal Submarine Acoustic Sensor (ACSAS) concept, and improved quieting has been achieved through design considerations.

The technology now being applied to the design of SSN 21 is available only because of earlier foresight in committing resources to basic research and advanced development in undersea warfare programs. As SSN 21 transitions from the drawing board to Fleet operations, it is vital that we continue to focus on future systems which will continue our qualitative advantage over the Soviet submarine force. We also recognize the need to continue refinement of basic hull, mechanical and electrical systems technology to provide greater power, higher tactical speed, enhanced quieting and increased performance/displacement ratios.

SEA LANCE To further enhance our submarine capabilities, we plan to enter Full Scale Engineering Development of Sea Lance (ASW/SOW) this year. The Secretary of the Navy is personally committed to achieving IOC as early as is feasible. This is a very important program in that it will provide our submarines with a much needed standoff attack and reattack capability against the improving Soviet threat. Progress of development and validation and initial technical testing have been highly encouraging with respect to achieving performance goals within cost and schedule.

Airborne Anti-Submarine Programs

A Milestone I decision for the next upgrade to the Maritime Patrol Aircraft, the P-3 Update IV, was approved in FY 1985. This upgrade will include a distributed data-bus architecture for the mission avionics, installation of the Enhanced Modular Signal Processor, new displays and integration of a new nonacoustic suite. Two contracts for a contractor demonstration phase were awarded earlier this year which will lead to a Full Scale Engineering Development decision in FY 1987. We are presently structuring a program to install new, more fuel efficient engines on the P-3 airframe to increase its range and endurance and intend to compete procurement of the P-3 Update IV (avionics, airframe and engines) in FY 1990-1991.

Another airborne ASW platform is the SH-60B LAMPS MK-III which successfully completed its first deployment in FY 1985. It has added a new dimension to our FFG-7's and the battle group ASW middle zone defenses. The SH-60B LAMPS III significantly increases the ASW capability of surface ships compared to the SH-2F LAMPS MK I. Also, a low cost solution to the replacement of the aging SH-3H carrier-based ASW helicopter is provided by the SH-60F, a variant to the SH-60B LAMPS MK III. A fixed-price development contract has been awarded for the carrier-based SH-60F helicopter with Navy technical testing scheduled for FY-1987.

Approval for limited production has just been granted for the S-3 Weapon System Improvement Program which is designed to upgrade the S-3's acoustic and nonacoustic capabilities. Fleet installations of this upgrade are scheduled to begin in FY 1988.

Surface Ship ASW

We have made strides in surface ASW programs in the last year. The Tactical Towed-Array Sonar (TACTAS) AN/SQR-19 is now entering production and will be installed on our cruisers and destroyers, as well as the active force FFG-7's. This system will complement the LAMPS MK-III system. Both the SQR-19 and the earlier SQR-18 are being upgraded in response to changes in the Soviet submarine threat.

The AN/SQS-53C Advanced Surface Ship Sonar successfully completed Milestone IIIA. Approval has been granted to build the AN/SQS-53C sonar for the DDG-51 and to procure long-lead material for three additional systems.

We have completed the Development Options Paper for the AN/SQS-89 ASW Combat System Improvement Program. The subsequently established Operational Requirement will guide the selection of a specific option.

Mine Warfare

The Navy is continuing an ambitious program which will ensure our ability to counter the evolving Soviet mine warfare threat well into the next century.

Using the additional funding provided by Congress, we have completed a study to determine the types of advanced mines required through the turn of the century. The two major recommendations of the study to be implemented are to improve the stockpile of mines to keep them abreast of the threat in shallow and deep water and to develop a new mine for medium water depths. We are also currently engaged in discussion with our allies on how to best proceed with a cooperative development program with our New Generation Mine.

The Navy's mine countermeasures program is directed primarily toward providing our MCM-1 and MSH-1 Class ships, and MH-53E helicopters, with state-of-the-art minesweeping, minehunting, and mine neutralization equipment. New sonars, remotely operated mine sweeping vehicles, and improved navigation and command and control systems head the list of systems in development to enable us to clear U.S. ports and selected overseas areas in support of our Allies, as well as to enable us to rapidly respond to worldwide contingencies such as the recent Red Sea mining incident.

STRIKE AND ANTI-SURFACE WARFARE

We are making the very best use of our new acquisition strategies to develop and rapidly field the weapon systems needed to reach out and take the offensive, when and if necessary, against heavily defenced land and sea targets. The quality and quantity of those defensive systems is driving us to develop standoff targeting sensors, precision standoff weapons and unmanned vehicles to greatly reduce costly platform attrition: costly in terms of precious hardware replacement and irreplacable in terms of our aircrews.

We believe our acquisition policies will help us to rapidly develop affordable non-goldplated systems; affordable not just from the size of the RDT&E bill, but also in terms of the historically elusive production and support costs. We are using more off-the-shelf technology and common subsystems in our specifications to allow for fixed priced development contracts and up front agreement on not-to-exceed production costs. We are using the best cost control tools possible, competition and requirements discipline, to gain the best price for the taxpayers' hard earned money. With continued Congressional and Navy support we expect industry to make the same investments and take the same risks that are made in the commercial market place.

Some of our major Strike and ASUW systems which need your continued support include: the A-6F Upgrade to the A-6E; the night attack systems for the F/A-18 and AV-8B, which will also be integrated into the A-6F; the tri-service Unmanned Air Vehicle Program; the SH-60B Penquin missile integration program; the HARM weapon system; the EA-6B Advanced Capability program and integration of the HARM missile; the TOMAHAWK weapon system and the Advanced Tactical Aircraft.

We have initiated the development of an Advanced Tactical Aircraft (ATA) with greatly enhanced survivability against the evolving threats and the ability to make our present and near term inventory of weapons more effective. The ATA system design will be robust against future threat growths and have the flexibility to accept new technologies and complement other missions. This program employs the acquisition strategies addressed earlier with competition built in from the start. We are capitalizing on developed and proven US technologies from other programs, and aggressively seeking commonality of technologies and subsystems between the ATA and USAF ATF.

I would like to add that your support and confidence in the F/A-18 program is really paying off. From its most recent deployments, the F/A-18 received nothing but praise from the fleet. Its maintenance hours per flight hour rate is the lowest rate for any tactical aircraft and continues to decrease. Its mean time between failure rate remains high. Quoting from a Battle Group Commander's post deployment report, "The bottom line is the F/A-18 is a winner that adds increased flexibility and offensive punch to the battle group. We like it." The integration of the night attack system will further extend the operational utility and flexibility of the F/A-18.

In addition to the F/A-18's fleet performance, we are extremely pleased with the HARM weapon system. The unit cost of HARM has decreased dramatically since its first production. From FY 1982 to FY 1986 the unit recurring flyaway cost has decreased from $589K to $266K, a 55% decrease.

As requested by the FY 1986 Conference Report, last fall Secretary Lehman and Secretary Orr certified for the Services that the HARM program meets its specification, is being constructed to the current data package, and will engage the intended threat. The FY 1986 Conference Report expressed concern that HARM containing the FY 1982/FY 1983 software was not performing or being produced as specified. This apparently stemmed from test results of F/A-18 firings which produced three successes of eight shots. These results continued to highlight known OPEVAL deficiencies including specific F/A-18 air flow field launch irregularities in the supersonic mode.

A configuration audit of the HARM missile was conducted by an independent government team lead by the Naval Avionics Center (NAC) beginning on 9 May 1985 and completing on 21 July 1985. The team was composed of 62 production and technical experts. The overall findings were:

- There have been no hardware or software changes that would degrade the overall missile performance.
- Analysis of all flight test results indicates that no performance degradation of the HARM missile has occurred since the operational evaluation baseline.

I am happy to report that since my testimony last year, HARM has achieved a high success rate. A majority of these shots were with missiles that incorporated the major software upgrade (FY 1984 software) which was designed to correct the problems identified in previous tests. These successful shots with the FY 1984 software included one shot in F/A-18 supersonic launch mode.

HARM is also receiving rave reviews from the fleet. Our pilots are finding new ways to use its versatile capability and its reliability has been phenomenal for such a complex system. We are so pleased with HARM that we are accelerating its integration into the EA-6B. In a step toward NATO commonality and interoperability, the Government of West Germany signed a contract in December to equip its F-4 and Toronado aircraft with HARM.

We are continuing the development of the HARM Low Cost Seeker (LCS) and the progress to date is encouraging. Both contractors, Ford and Raytheon, are fully onboard and we are optimistic about their ability to meet Secretary Lehman's commitment. In fact, we are studying the possibility of accelerating the LCS schedule.

We are also looking at applying the technology in other areas where we have stong operational requirements. As an example, under the ERASE Program, we are looking at a self defense reactive ARM for our fixed wing aircraft.

We are updating our comprehensive Anti-Radiation Weapons Roadmap with the other services, and have tied it in with our Strike/ASUW Master Plan. We are looking at a broad spectrum of weapons including HARM, the Dual Role ARM concept, low cost saturation weapons and other special programs. In this way we look at the biggest picture possible to ensure we minimize the number of weapons involved and come up with the most cost effective solution to common Service requirements.

## ANTI-AIR WARFARE

Let me now build on discussions that I had with you last year on programs in the Anti-Air Warfare area.

### Airborne AAW

Our AAW strategy requires the destruction of enemy threat platforms and airborne weapons whether launched from air, surface, submarine or land.

The growing capability of the enemy has driven a series of improvements to the E-2C since its introduction in 1971. With the E-2C programmed to be aboard our carrier well into the twenty-first century, we are driven to continue to upgrade the E-2C to keep it abreast of the threat. Two block upgrades are planned for the E-2C. Group I will increase the automation of the system by incorporating a high speed data processor that will increase surface ship detection, increase the number of targets that are currently handled and provide improvements for electronic counter-counter measures. Concurrent with the introduction of Group I is the incorporation of an engine upgrade to improve single engine performance at low altitude on hot days. Group II will further increase the radar performance.

The F-14A is our primary fighter in the outer air battle. As with the E-2C, the growing threat has forced us to update the F-14. To accomplish this in an economical fashion and achieve a high degree of commonality among our major tactical aircraft, the Navy embarked on the F-14D and A-6F projects in which both programs share over eighty percent subsystems and software commonality. These subsystems will also have maximum commonality with F/A-18 and AV-8B. The F-14D with its new engine, new avionics and new radar offers a system that will be effective well into the twenty-first century. Competition has kept the price down; firm management has kept us out of redundant programs; commonality has permitted us to add more capability to our force in a shorter time and at less cost. We have signed a contract with Grumman for a fixed price F-14D development program and three years of procurement under firm not-to-exceed options.

An important element of anti-air warfare is of course the air-to-air missile. In this area I think the Navy has an excellent track record in providing systems with outstanding capabilities such as SIDEWINDER, SPARROW and PHOENIX. As the threat grows in capabilities and our technology is compromised, we must continue to pursue upgrades to these basic missiles that will make up the major portion of the inventory through this century. These upgrades of current systems are the ASRAAM which is being developed by NATO as a follow-up to SIDEWINDER; the AMRAAM being developed by the the USAF as a follow-on to SPARROW; and the AAAM being studied by the Navy as a possible follow-on to PHOENIX. SPARROW (in the surface-launched version) and SIDEWINDER are NATO consortium and Japanese coproduction programs.

Each of our missile programs will be developed and procured under policies established by the Navy for competition at all levels, firm fixed-price contracts, and commonality where it makes sense.

### Shipborne AAW

Last year in my remarks to you, I discussed improvements we were pursuing in offensive standoff capability, battle group air defense against anti-ship missiles, reduced weapon reaction time, and improved ability to put weapons on a target in a timely and accurate manner.

We have also been working on ways to create a synergistic relationship among our systems and ships. We have demonstrated the feasibility of one such concept that improves individual system performance through interoperability at no increase in cost.

In this demonstration, we successfully engaged targets with standard missiles using search data from an AEGIS cruiser. Engaging the SPY-1 radar target of the AEGIS cruiser with weapons from other ships of the force allows us to defeat our enemy and capitalize on the capabilities of the New Threat Upgrade (NTU) combat system.

Another system that will provide a high leverage payoff is the Naval Airship. This system is scheduled for an FY 1987 new start. We are examining the Airship primarily as an early warning platform to increase our reaction time against high-speed, low-flying anti-ship cruise missiles. It is another smart, simple solution which can provide cost effective, long endurance, organic airborne early warning and improved battleforce asset management capability to CV Battle Groups, Surface Action Groups, Underway Replenishment Groups, Amphibious Task Forces and convoys. The airship's ability to carry aloft large payloads will enable us to use a large aperture, low frequency radar to detect the threat missiles. The Airship can also act as a force multiplier by improving force coordination in anti-surface, strike, and anti-submarine warfare mission areas. We will examine potential capabilities for the Airship with a view to developing a platform that will provide high leverage in several mission areas, be either manned or unmanned and be affordable in numbers.

Another area I would like to report on is our efforts to broaden the industrial base for both development and production of naval systems.

One example of this, which I mentioned earlier, is the AEGIS combat system, which has been broken out into six major weapon components to permit competitive procurement of each, beginning this fiscal year. By 1990, all of these components will be competitively procured. Additionally, we have recently initiated an effort to compete the shipboard integration and associated production system testing of the AEGIS combat system.

A program we structured for competitive procurement when transitioning from development to full production was the Vertical Launch System (VLS). Initially, VLS production unit costs were budgeted at $30.7M and $32.8M for FY 1985 and FY 1986 respectively. Average competitive procurement unit costs for the launchers purchased in FY 1985 was $17.3M. In the FY 1986 buy, the average competitive cost dropped to $15.6M per launcher, even though fewer launchers were purchased. Based on the FY 1985 and 1986 competitive procurements alone, $288M has been saved based on the original budgeted costs over the two years of procurement.

The 5-inch Rolling Airframe Missile or RAM is a program that we are structuring for competitive procurement starting with the first production buys. Recent instrumented flight test vehicle firings have provided missile flight performance data verifying that proper design parameters have been used to correct missile component design deficiencies, which became evident after experiencing high failure rates in the flight test program. The previously suspended flight test program has been reinitiated. DT/OT firings are planned to be completed early in the first quarter of FY 1987.

The RAM Procurement strategy entails dual production in the United States and Germany. It is planned that the U.S. will build a production line at General Dynamics/Valley Systems Division and the German government will establish a production source within Germany. A leader/follower arrangement for production will be provided utilizing General Dynamics as the leader. Initial limited production is planned for FY 1987, with full competition not later than FY 1989. We hope that we can count on your support for this system, not only because of its implications for U.S. naval forces, but also due to the commonality and interoperability it represents with an important NATO ally.

Industry wide participation was solicited this past year to assist the Navy in helping to determine a realistic set of options for an Outer Air Battle system concept. The structured study phase was designed to capitalize on system/component approaches that industry feels could best counter threats in the late 1990's and early 2000's. We signed six separate contracts with various industry participants to provide their best technical AAW defense approach for the Navy to consider. Contractors were to investigate system approaches for both advanced air-to-air missiles (AAAM) and advanced surface-to-air missiles (ASAM). The contractors were asked to address commonality in their proposals. Ideally, a single missile development should fulfill both the air-to-air and surface-to-air missions. This missile could be launched directly from aircraft and boosted from vertical launchers on surface ships. If the single missile approach does not prove cost effective, common technology applicable to both missile systems should be maximized, i.e., missile guidance signal processing, propulsion, ordnance, etc. A development option paper will be provided for a Navy/DOD determination on how best to proceed with the follow-on AAW system for the year 2000 and beyond. The Milestone I decision will occur in the April/June 1986 time period.

My discussion of initiatives in the area of Anti-Air Warfare clearly demonstrates the benefits of competition early in development and in early phases of production.

AMPHIBIOUS WARFARE

Amphibious warfare remains an integral part of our maritime strategy. We are moving forward with programs in this mission area that will ensure the Navy/Marine Corps team has the operational capabilities needed to execute the strategy in the threat environment of the 1990's.

Two of our highest priority programs, the V-22 OSPREY tilt-rotor aircraft and the Landing Craft Air Cushion (LCAC) will provide a quantum jump in capability to project forces ashore by providing a true over-the-horizon assault capability.

The V-22's speed, range and productivity will revolutionize the way we conduct amphibious assault. This tri-service tilt-rotor aircraft will replace the aging CH-46 assault helicopters in the Marine Corps and will meet the Navy's critical combat search and rescue requirement with the baseline aircraft. Navy planning has commenced this year to develop an ASW variant by the mid-1990's.

The V-22 has completed a highly successful preliminary design phase and is getting ready to transition into full scale development. During preliminary design over 5000 hours of wind tunnel testing have been completed giving the program a sound technical footing and significantly reduced program risk.

The V-22 acquisition strategy maximizes competition. The full-scale development contract is a fixed-price type contract and the production phase will be competed from Lot 1 throughout production. The engine full scale development competition has been completed. A second source will be selected to participate in both the development and production of the engine.

Acceptance testing of the LCAC to date has clearly demonstrated the potential operational effectiveness of this new assault craft, but we have experienced design suitability problems primarily in the area of reliability and maintainability. Fixes for major design deficiencies have been identified and we are aggressively pursuing management initiatives to resolve them. Most significantly, we have brought in a viable second source that will not only drive down the cost but also apply the pressures of competition on the quality of the product.

The need to provide fire support for over-the-horizon assaults has generated new requirements for longer range fire support systems. In response to Congressional direction, we have recently completed a major study of naval fire support requirements in the 1990's. We also have initiated high-payoff projects to increase range and lethality of existing systems such as the saboted subprojectile for the 16-inch gun, as well as examining requirements for single-purpose fire support ships and new systems. Also at your urging, we have taken steps to bring on a second source for the Five-inch Semi-Active Laser Guided Projectile (SALGP). We have initiated a block change to the guidance section that will streamline manufacturing and reduce costs by replacing customized components with off-the-shelf parts. We expect to have full competition by FY 1988.

As you recall, we decided last year to cancel the LVT(X) and defer development of a new assault amphibian until the early 1990's. In the interim, the Marines continue to upgrade the AAV7A1 fleet to enhance its survivability and improve reliability and maintainability.

The Light Armored Vehicle (LAV) program continues to be a resounding success. The Marines have the first LAV battalion operational at Camp LeJeune and the second forming up on the West Coast. We have over 289 of the basic 25mm gun versions on hand and deliveries of three of the other mission role vehicles are beginning. We are ready to commence FSD of air defense and assault gun variants which will round out the LAV family.

We are continuing with the Dragon antitank missile improvement program to provide the Marine Corps an interim capability prior to the Army fielding the Advanced Antitank Weapon System - Medium (AAWS-M). We have structured a competitive program for the development of three product improvements to Dragon. In addition to an enhanced warhead which will improve Dragon's lethality, the Marines will also increase the missile range and speed and combine the day and night trackers into one countermeasure-hardened, reduced weight unit.

## CONCLUSION

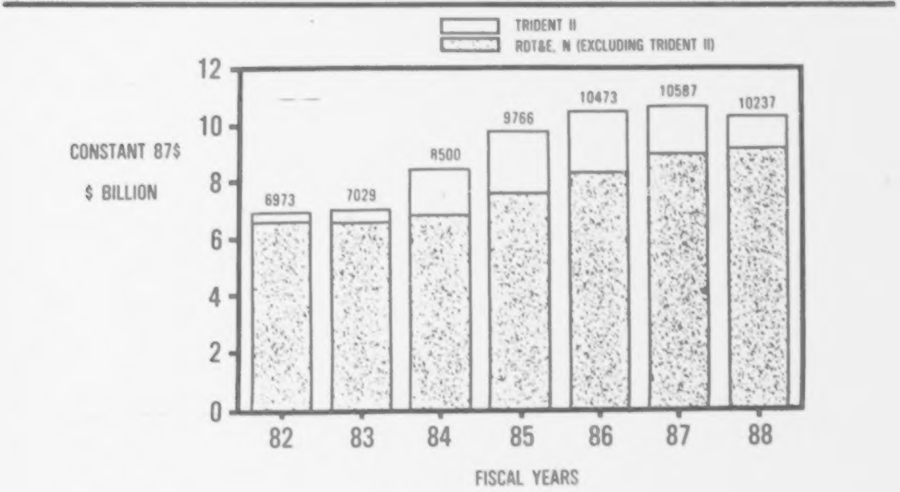
Let me close with Secretary Lehman's answer to the question of whether we are developing the right Navy and Marine Corps for our strategy. Because research and development projects span decades, and ships take many years to build, the makeup of our fleet and fleet marine forces cannot change radically with each administration. Instead, they evolve over time with policy and technology. The fleet today reflects the wisdom of the deck plates, the labs, and lessons learned from our exercises. The size and design of our ships and weapons reflect the inputs of sailors in contact with Soviet submarines, Kiev-class carriers, and "Bear" aircraft. The wisdom of common sense and the highest available technology are tremendous advantages and these we must bring to the design of today's Navy and Marine Corps.

## STATEMENT OF VICE ADM. ALBERT J. BACIOCCO, JR., USN, DIRECTOR, RESEARCH, DEVELOPMENT AND ACQUISITION, OFFICE OF THE CHIEF OF NAVAL OPERATIONS

Admiral BACIOCCO. Mr. Chairman, I would like to present a very brief overview of the RDT&E budget that the Navy has submitted with the President's budget for fiscal year 1987.

Our budget request for fiscal year 1987 totals $10.6 billion, about 10.2 percent of Navy's requested total obligational authority. I invite your attention to notice that this is $700 million less than our fiscal year 1986 request.

## NAVY RDT&E

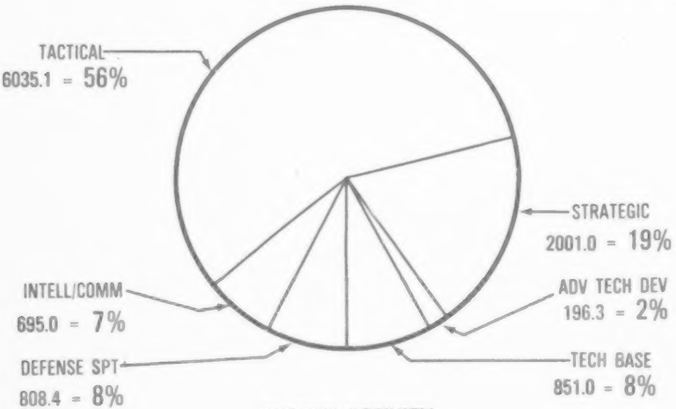


The slide you see before you is a bar graph presentation of the trend in Navy RDT&E. You will note that the strategic programs, Trident II, is shown above the solid standpipe. As you can see, in fiscal year 1987 Trident II funding is decreasing, as that program reaches maturity. As such there is a downward trend beyond this year, FY 1987, in Navy RDT&E.

We have accomplished these reductions, and this trend, through the better management and acquisition initiatives described by Mr. Paisley. You will also note that our request this year is very close to the amount appropriated last year. And, as I said, a factor contributing to this is the fact that the Trident II R&D requirements are beginning to decrease as this program reaches maturity.

## NAVY RDT&E

### FY 1987 BUDGET REQUEST = $10,586.8M

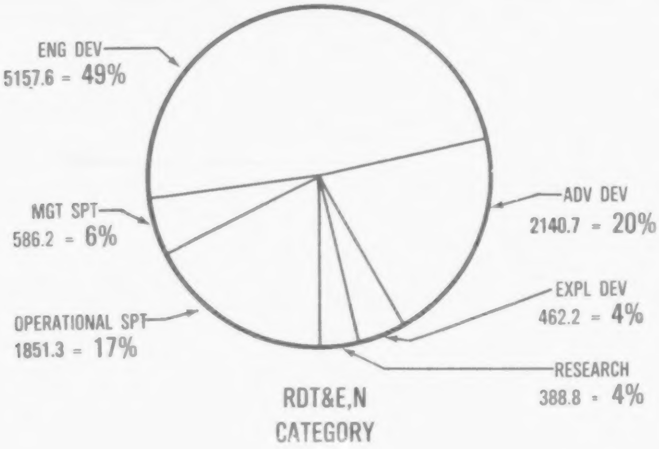


BUDGET ACTIVITY

Our budget request can be viewed from three perspectives. First, by budget activity. The largest portion is devoted to tactical programs, some 56 percent of our request. This includes programs such as the SPY-1D radar and our SSN-21 R&D efforts. Strategic programs receive about 19 percent of the budget. These resources are predominantly for development of the Trident II-D-5 missile system. The remainder goes into our important technology base, advanced technology, intelligence and communications and defensive support programs.

**NAVY RDT&E**

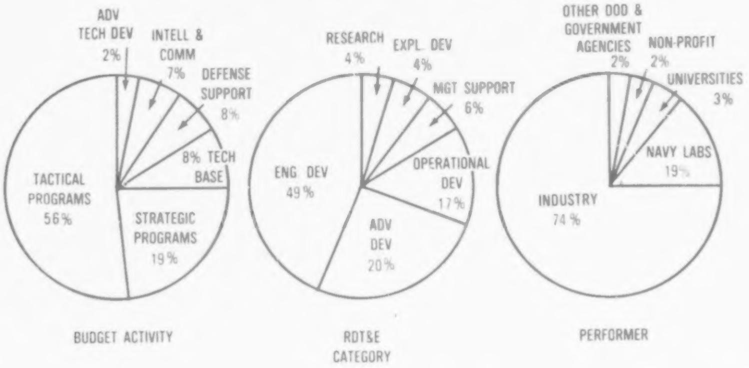
**FY 1987 BUDGET REQUEST = $10,586.8M**



Another way to look at our request is by RDT&E category. Here, the majority of funds go to engineering development programs, such as Sealance, the MK-48 ADCAP torpedo, and our Submarine Combat Systems efforts. Programs in advanced development comprise about 20 percent. Operational development programs, such as SURTASS, account for 17 percent of the overall amount. The remainder is devoted to efforts in basic research, exploratory development and management support.

## NAVY RDT&E

FY 1987 BUDGET REQUEST = $10,586.7M

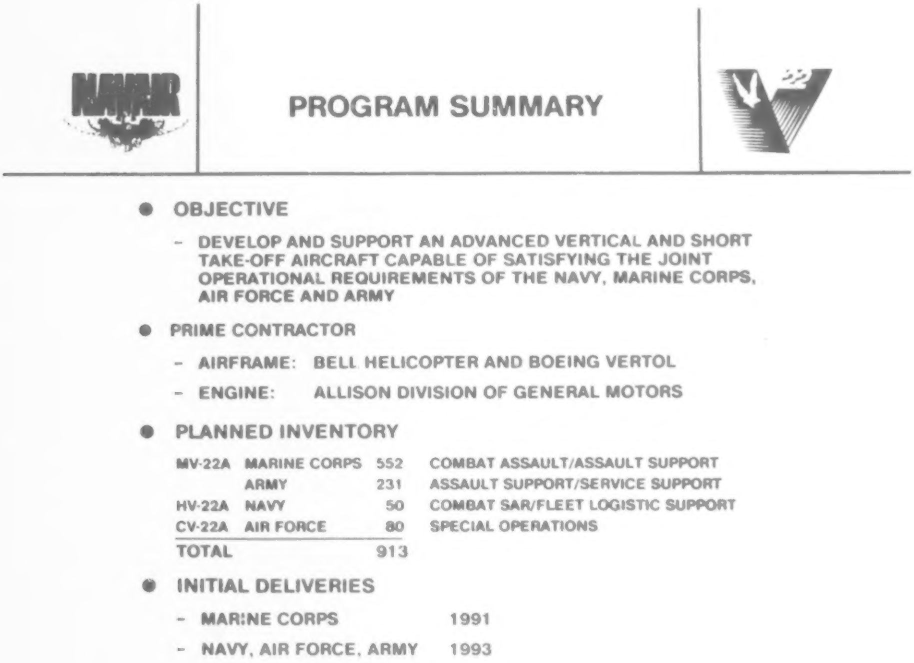


Finally, one can view the budget request in terms of performers. Here we see that industry accomplishes the majority of our work, about three-quarters of the work funded by Navy RDT&E, with Navy labs at about 19 percent. The remainder is performed in universities and other Government agencies.

Mr. PAISLEY. With that, I would like to introduce Lieutenant General Smith, who is going to talk on the V-22 Program.

## STATEMENT OF LT. GEN. K.A. SMITH, U.S. MARINE CORPS

General SMITH. Good morning, Mr. Chairman, distinguished members of the committee.



PROGRAM SUMMARY

- OBJECTIVE
  - DEVELOP AND SUPPORT AN ADVANCED VERTICAL AND SHORT TAKE-OFF AIRCRAFT CAPABLE OF SATISFYING THE JOINT OPERATIONAL REQUIREMENTS OF THE NAVY, MARINE CORPS, AIR FORCE AND ARMY
- PRIME CONTRACTOR
  - AIRFRAME: BELL HELICOPTER AND BOEING VERTOL
  - ENGINE: ALLISON DIVISION OF GENERAL MOTORS
- PLANNED INVENTORY

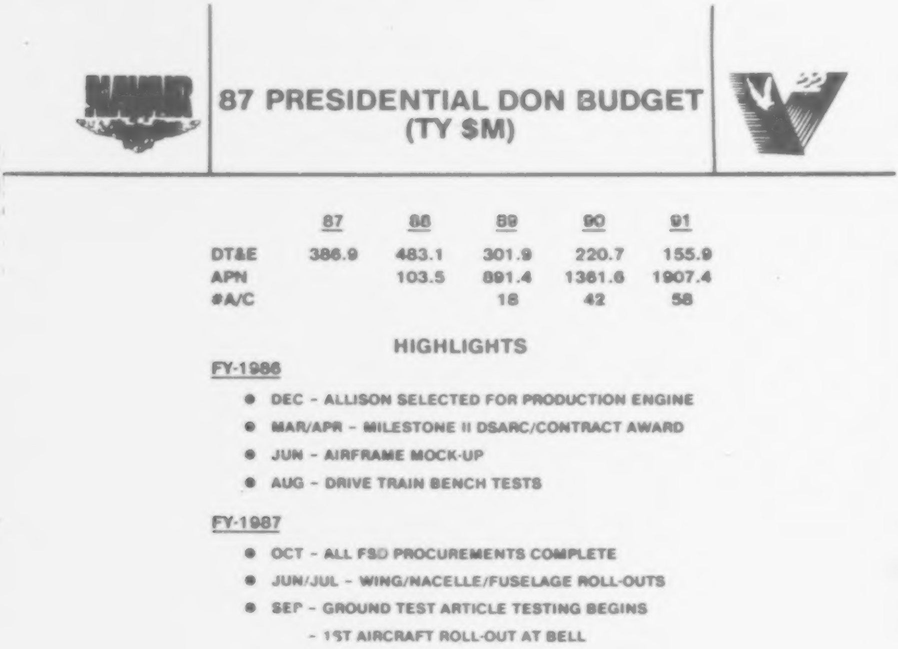
| | | | |
|---|---|---|---|
| MV-22A | MARINE CORPS | 552 | COMBAT ASSAULT/ASSAULT SUPPORT |
| | ARMY | 231 | ASSAULT SUPPORT/SERVICE SUPPORT |
| HV-22A | NAVY | 50 | COMBAT SAR/FLEET LOGISTIC SUPPORT |
| CV-22A | AIR FORCE | 80 | SPECIAL OPERATIONS |
| TOTAL | | 913 | |

- INITIAL DELIVERIES
  - MARINE CORPS 1991
  - NAVY, AIR FORCE, ARMY 1993

We are asking this year for continued support in the development of the V-22 helicopter tilt rotor aircraft, which is the replacement for our aging and diminishing CH-46 fleet. As you can see on the slide, the objective is to develop a short takeoff aircraft which meets the joint service requirement.

The prime contractors are Bell and Boeing for the airframe and Allison Division of General Motors for the engine. The numbers required for all four services total 913 aircraft. We expect this total number to grow during this next year as the other services, Navy, Air Force, and Army, realize the potential this airplane is going to provide.

Initial deliveries to the Marine Corps commence in 1991, which is the year that our CH-46 fleet drops below the capability of lifting a MAF and a MAB simultaneously. Initial deliveries to the other services start in 1993.



**87 PRESIDENTIAL DON BUDGET (TY $M)**

| | 87 | 88 | 89 | 90 | 91 |
|---|---|---|---|---|---|
| DT&E | 386.9 | 483.1 | 301.9 | 220.7 | 155.9 |
| APN | | 103.5 | 891.4 | 1361.6 | 1907.4 |
| #A/C | | | 18 | 42 | 58 |

HIGHLIGHTS

FY-1986

- DEC - ALLISON SELECTED FOR PRODUCTION ENGINE
- MAR/APR - MILESTONE II DSARC/CONTRACT AWARD
- JUN - AIRFRAME MOCK-UP
- AUG - DRIVE TRAIN BENCH TESTS

FY-1987

- OCT - ALL FSD PROCUREMENTS COMPLETE
- JUN/JUL - WING/NACELLE/FUSELAGE ROLL-OUTS
- SEP - GROUND TEST ARTICLE TESTING BEGINS
  - 1ST AIRCRAFT ROLL-OUT AT BELL

The dollar figures appear on this chart. Last year, of course, you gave us $580 million in the 1986 budget, and in 1987 the budget request is $386.9 million. This gives us the basic funding to get started on the program, which includes six full system development articles.

APN starts in 1989, although you will see on the slide that it starts in 1988. This is a function of the time it took us to develop a sound business arrangement with the primary contractors. The airplane is now on the business basis we desire.

This program remains the Commandant's and the Marine Corps' highest priority of the aviation programs we are presenting to the Congress this year. It is a radical improvement in lift capability for the Marine Corps. I stated last year—and I reaffirm it this year—we view this technology introduction to be the greatest single evolution in Marine aviation since the inception of the jet engine. It gives us the capability to stand off from the assault area.

To establish the context in which I am talking here, if you have an amphibious force standing 200 miles off the Virginia capes can by the next morning land anywhere from New York to the Florida-Georgia border. This complicates the enemy's defensive situation to the point where they can't cope with the threat. It is a significant enhancement, one that will stand this Nation's force projection capability in good stead in the 1990's.

I am ready for your questions.

Mr. **Price**. Are there questions at this time?

Mr. McCurdy.

Mr. **McCurdy**. I did have a question on the JVX or V-22, whichever we are using today.

General, I think there is some interesting development here, and I think most Members have been impressed with the early prototype, the smaller version, and that the concept is valid.

I think the question that I have been hearing and that needs to be addressed is that this is, as you indicate, the Marines' top priority. But the question I am hearing from the other services is that it is certainly not one of their top priorities, and that in all due respect they are barely even giving it lipservice.

I have talked to MAC in the Air Force, and I think the Navy. They say, yes, if it ever gets developed, we will take some. But this is not exactly our high priority. We are just concerned about, in this type of budget constraint, whether the per unit cost—and whether to drive it down based on this heavy R&D and the production—that you will ever satisfy the number of units to make this a cost-effective aircraft.

We are talking now of $35 or $40 million a copy, if you go through the full buy. What happens if down the road the Navy says, well, we really don't need it, or the Air Force says we have got another vehicle that can take its place? Aren't we going to end up with an extremely expensive aircraft for what appears to be just a Marine bird?

Mr. **Paisley**. General Smith, let me say something about that.

We haven't done as good a job as we should have in pinning down over the last year commitments from the services, including our own in the Navy. The biggest accomplishment that we have made is that the Secretary has told the blue suit Navy that we are not going to open the S-3 line again. It is closed for good.

I am going to have Admiral Baciocco talk to you a little bit about a conversation that he has had with the Air Force, and our commitment in terms of a replacement for the S-3. I think we do need those commitments, and the larger the buy always the better off you are.

So, let me have Admiral Baciocco talk to you a little bit about it. I think that the first, No. 1, thing we have got to do is get the blue suit Navy commitment on paper.

Go ahead.

Admiral BACIOCCO. The present program, of course, has some 500-plus Marine Corps aircraft and 50 Navy aircraft, which are combat search and rescue aircraft. They are documented. They are in the program. The Navy is finishing up the formal process to establish the operational requirement for the follow-on to the S-3 Viking carrier-based ASW aircraft. This requirement reflects that the follow-on will be a variant of the V-22 aircraft.

The budget formulation process that we are going through right now for our 1988 budget, which you will see next year, will have a program to develop the S-3 follow-on variant of the V-22 aircraft. This variant would have a first flight in 1992, with the first deliveries in 1995. You will see the money developed for that.

The acquisition approach for those aircraft would be to modify two of the baseline aircraft, and use some off-the-shelf of ASW systems, such as our P-3 update or current S-3 equipment. We have to do some design work to have a pressurized cabin for the aircraft, because they will have to operate at higher altitudes than the current baseline V-22. We would proceed with a program that could be as high as 300 ASW aircraft.

Mr. McCURDY. Do you have a chart, General, or a graph, to show us the actual size that is going in full-scale development, compared to the original light version that you had?

General SMITH. No. It does not.

Mr. McCURDY. How large is this aircraft?

General SMITH. I will let the program manager give you the specifics on it. But the XV-15, which is the flying prototype, is about 35 percent the size of the actual airplane that we are going to be flying.

Col. Harry Blot is the program manager, and he will relate the specs to you.

Colonel BLOT. The relationship between the XV-15 and the V-22, which will be production version, the V-22 is twice the size of the XV-15 and three times the weight.

Mr. McCURDY. Three times the weight? And you have had successful tests and flights on the small version, the 10,000-pound version?

Colonel BLOT. Yes, sir.

We have flown one. Then we put in over 6,600 hours of wind tunnel tests to see if we can make the jump from one airplane size to the other. We have convinced ourselves the performance factors evaluated indicate we can get the required performance out of the larger variant.

Mr. McCURDY. What about the engine itself?

Colonel Blot. The engine itself, the size and the horsepower required to drive a machine of this size, has been predicted. We put out a specification. Companies responded to that specification. And we chose the one that was the cheapest cost alternative, and could still provide us the required power.

Mr. Paisley. Mr. Congressman, your questions are associated with risk on the program?

Then, let me say something about that. One of the ways you can really find out if there is a risk in a program is to structure a good, solid fixed price contract with the warranty and schedule penalties in it. A contractor will not sign a firm fixed price contract if risk as not been adequately reduced. I am happy to say on the airplane and the engine we have, we were able to negotiate fixed price contracts. That is the best measurement of risk you can get.

By the way, there was a lot of thought that went into this concept. It took us quite a while to get these contracts drawn up. And that tells me this program is going to come off for the dollars we have and the risk we are now sharing with the contractor. He won't step into these things lightly.

You asked a question about the flying prototype. That is a functional airplane. I am not sure how familiar you are with the thing. Most of the Marines in here that fly have probably flown it. I have, myself. It is a functional airplane. There isn't any question about the concept itself.

Mr. McCurdy. I have heard that. I don't think there is any question that the live version performed according to the spec. I am just curious about what risk there was, and also as to the overall commitment for this.

I just have a hard time, every time we come up here, supporting another $50 million copy airplane for the Navy or the Marines here. I guess it really comes down to, is the Navy willing to put a high enough priority that they are going to sacrifice other things? You can't have it all this year, and that is the dilemma that we are sitting with here, and we are getting ready to start another program and go into production, and there is a lot of competition out there.

Are you willing to trade Tacamo for this? Are you willing to trade other things? That is the kind of question that we have to ask.

Mr. Paisley. I am not telling you what we would trade for it.

Mr. McCurdy. I know. You never do.

Mr. Paisley. I know. But let me say something.

This program has one of the highest priorities in the Department of the Navy.

Mr. McCurdy. Is it a higher priority than Tacamo?

Mr. Paisley. I think you can say that the Secretary testified over here on that question.

Mr. McCurdy. Refresh my memory.

Mr. Paisley. That question was specifically asked of the Secretary, not between the V-22 and Tacamo. They asked him what was his feeling about the priority of that program. As I recall, what he said in testimony was it is the first program that will have to go, if you have to take a program out.

Didn't he say that in testimony? I think he did.

Mr. McCurdy. That is last year. I think that is correct.

Mr. Paisley. Yes.

Mr. McCurdy. Thank you.

Mr. Paisley. One thing I would like to do is clear up the unit cost of the airplane.

General Smith. The procurement unit cost that appeared in the 1984 SAR in 1984 dollars was $21.5 million. The next that you see in the December 1985 SAR will be $21.1 million. In then-year dollars the procurement unit cost in 1985 SAR was $35.6 million. The one you see in December 1985 will be $29.6 million. So, the cost is coming down, in line with the business arrangement we have put together, to drive the cost within the box.

Mr. McCurdy. How can you judge that when you are not in production? You are saying, based on the subcontracts you think you are getting, that this will drive the cost down eventually?

General Smith. With the firm fixed price R&D contract we have got not "to-exceed" estimates on first four lots of airplanes they are going to produce. They have committed themselves to a lower unit cost than was originally estimated by the program manager.

Mr. McCurdy. For the first how many birds?

General Smith. I believe it is four lots.

Mr. McCurdy. The first three lots.

For one bird?

General Smith. The first four lots. That will be about 130 airplanes.

Mr. Paisley. And then you have to remember now that this airplane in that time frame—these are not to exceeds. We have never, that I know of, in the Navy, ever paid a contractor the value of a not-to-exceed. It has always been less. We have always negotiated the price lower. And in that timeframe, we have two contractors competing for that program in the second buy, from then on every year.

Mr. McCurdy. So, you are saying they are now $29 million?

General Smith. $29.6 million versus $26.6 million in then-year dollars, which is last year's SAR. That is roughly $7 million less a copy for production, and we expect it to go down more.

Mr. McCurdy. How much in this year's dollars?

General Smith. In 1984 dollars, it is $21.1 million.

Mr. Price. Mr. Dickinson.

Mr. Dickinson. Thank you, Mr. Chairman.

Mr. Secretary, I appreciate your being here. I am sorry I was not here at the very opening, but I had to dig out of snow twice this morning, and I didn't anticipate the second one, but the snowplow came by and helped me out.

We are happy to have you with us. Just in terms of some general statements, I agree; I read your statement and I agree with much of what you say.

Just a personal observation that I really think is justified. I think the Navy has an inordinant amount of problems in making a decision and then being able to carry it out. I am talking specifically R&D, but other programs, too.

It looks like somewhere in the bowels of the Pentagon things go askew. I can think of one program in particular which I finally had to come and get you to help me with. It was a tape drive for a company that had the cheapest program, the longest running and most dependable product, and they signed off on it, won the competition two or three times and nothing ever happened.

Finally, I came to you and you took it away from the contracting officer and took it into your own shop. And, sure enough, that is right and we got it solved.

I think all too often this is typical. The best man doesn't always win, and the winner doesn't always get the product. I don't know if you have a budget system over there or what, but sometimes it really stinks.

Let me ask you, just for my own edification, getting back to the JVX and LHX, is there a comparison between these two birds? What is the function now of the light helicopter experimental LHX and the JVX? Is the JVX just to be a card in the people hauler, or is it a fighting weapon?

General SMITH. The V-22 or JVX, as you call it, is a people and things carrier. It moves equipment, fighting forces, Medevac, those types of mission from point A to point B. It will function in that role in the assault, in the logistics resupply, those types of areas.

The LHX is a much smaller, reconaissance and gun ship type airplane, which is not yet fully crystallized.

Mr. DICKINSON. So we are really talking two totally different functions.

General Smith, this committee, this particular committee, was onboard in support of the JVX long before the Navy was. We have gone through the birth pains of, yes, we might want it, this looks good; the Air Force, the Army want to sign up, and then they bail out and the other one signs up. The Marine Corps came onboard and said they wanted it, and the Navy wasn't that enthusiastic about it, and we had to find somebody to buy the first bird.

Everybody is onboard now, as far as the Navy is concerned. I am very pleased with this.

But, getting back to Mr. McCurdy's point, it gets to a question of affordability, and we have a real problem here, and that gets to a question of how many units we buy.

I don't think you are going to expect—I don't think you'd expect—I don't think you are going to receive much assistance from the other services in increasing your unit numbers, because they are all marching to a different drummer right now where they have different needs. And the Air Force says, yes, it is a nice thing, but maybe in 1990-something we might need some of these. The Army says, well, you know, it is nice to have, but right now we are going with the LHX and we are going to the Apache and we are going with other various rotor lift pieces.

So, I really think that the burden in the final form has fallen on your shoulders, and the Navy, and I hope that we can get the cost down to the point where it is affordable, and we, with the budget constraints that have been put on us, are able to sign up to this and go forward with it, because I think it is a vital concept for COD, for people movers, for assault vehicles. I think you will find us sympathetic and probably supportive.

I do not want to let one statement go that Secretary Paisley made in his statement here. I want to commend you for it.

Quoting you:

We are talking about the keynote of the Navy's terminal phase EW strategies commonality. To this end, we are examining all our EW programs or requirements while conferring with other services. Our recent cancelling of Navy JTIDS and restructuring of the Air Force in line with JTIDS is related to commonality.

How did that come about, Mr. Secretary?

Mr. PAISLEY. You made us do that. You know that; you sure do.

Mr. DICKINSON. We drag you over the line. Sometimes, we micromanage, and finally get it.

I wanted to share in basking in the reflected glory here of our commonality here.

I thank you, Mr. Chairman. I yield back the balance of my time.

Mr. PRICE. Mr. Badham.

Mr. BADHAM. Mr. Secretary, or General, in the scaling up from the X-15 or whatever it was, or XV-15, to the V-22, I understand there were some problems with the transmission and the shaft and those sorts of things to get the cross-power and all of those things.

What is the reliability and confidence on that now?

Mr. PAISLEY. Harry you ought to talk about that.

Colonel BLOT. Yes, sir.

When we up-sized from the prototype to the full-scale V-22, the Naval Air Systems Command during the preliminary design phase requested that several tests be done both for strength and reliability and maintainability. Those tests were accomplished and showed that we had the reliability that we needed and the power that we needed of the transmission.

We have sized those. They are understood. The specification is out and the contractors have agreed to build them at their risk.

Mr. BADHAM. At their risk.

Can you give me an indication of the size of the main rotors on those?

Colonel BLOT. Sir, they are 38 feet.

Mr. BADHAM. That is what it says.

Colonel BLOT. But if you look at them, they are smaller than the CH-47 or the 53A. So we are not pressing the state of the art.

Mr. BADHAM. Just so they don't land with their rotors down.

Colonel BLOT. Yes, sir.

Mr. BADHAM. Let me ask you, Secretary Paisley, I have been getting a little bit of concern over one thing that you are bragging about that other people are not necessarily bragging about, and that is the greater use of competition, earlier use of fixed price contracts in the R&D cycle, and increased contractor investment.

Have you started to notice yet any more reluctance on the part of contractors to do all this stuff and not get anything back at the end? How is that working out?

Mr. PAISLEY. It started out and all of the contractors were complaining; I would say screaming and moaning. And we have taken the V-22, the engine for the V-22, the T-45, the A-6F, the 14-D, the SUBACS program, and on every one of these programs the contractors have come around to say yes.

And, by the way, I don't think you are going to see any reluctance. We have worked it out. We are flexible. By the way, the big thing that has caused all of the complaints is the tooling, but every one of them agreed. We straight-line, allow them to straight-line, and amortize the tooling off over the program. It is absolutely going to be a good deal for the Government. We are going to pay less and less for tooling as we go down the road.

If you put tooling in the capital budget of a corporation it goes to the chairman of the board for approval. I had never seen a capital budget go to the chairman of the board that he didn't spend a week on the thing with all his people cutting it down, finding out how to do it better.

We have got the top management in the corporations working on our programs in the Navy now. You are just going to find time after time that the tooling costs are going to be less, I have not had problems with the contractors in sitting down and negotiating these things.

You have to be flexible. For instance, when we started out, we had not intended to refurbish the R&D tooling and give it to the contractor. We intended that he would do that. We changed that. We refurbished the R&D tooling. We hold the title to the R&D tooling. He buys the production tooling when we have committed to production at milestone 3. I think it has come along fine.

Mr. BADHAM. The engine for the V-22, the T-45 training system and the F-14D and A-6F, there is really not that much new there. Maybe Tony would like to turn AMRAAM R&D over to you, see if we can get some fixed price stuff on that. It couldn't get any worse than it is now.

Mr. PAISLEY. I see no reason not to fix price. Ninety-five percent of all the programs we will ever do in the future will be fixed price in the full scale engineering development phase.

Mr. BADHAM. In the long run, will we sacrifice technological excellence and technological risk in order to stay in fixed price on R&D?

Mr. PAISLEY. No, not at all. You do the advance development under a cost plus contract. Contractors will not sign up for a fixed price contract the way we have got them structured, when there is risk in there that he can't afford. This is no different than what is done commercially. There is no point in the Government getting up and paying and having all the risk, and doing all the investment.

Let the contractors do it. They make profit out of this business, and they ought to invest in this business.

Mr. BADHAM. Thank you.

Mr. PRICE. Mr. Hertel.

Mr. HERTEL. Thank you, Mr. Chairman.

I want to congratulate you, too, whatever has been accomplished.

I want to start a discussion on another form of communication. I have read in the statement about E-6A and your plans, but maybe I have missed it. I came in late. But I see nothing about the satellite communications system.

Is that in here that I have missed someplace?

Mr. PAISLEY. No. We are going to take that up when we close this session. We are going to close this session right after this portion of the briefing.

Mr. PRICE. When we reach a point that you can't discuss anything in open session, let me know.

Mr. HERTEL. Thank you, Mr. Chairman. I agree with that.

What can you tell us about it in open session, the progress that we have made with the satellite communication?

Admiral **Baciocco**. The program to which you refer, sir, is the Satellite Laser Communication or SLC Program. We are all familiar with the E-6A program, Tacamo. That is a program that has been in being for a long time, the TACAMO capability for EAM delivery.

Mr. **Hertel**. I was one of those on the subcommittee that helped get the funding for that last time.

Admiral **Baciocco**. Yes, sir.

Mr. **Hertel**. I have some questions about the progress that has been made in the alternative with the satellite communication.

Admiral **Baciocco**. I do not believe that the SLCSAT is a near-term alternative, if an alternative at all, for the Tacamo system. The program that we have had with DARPA for the last few years on the blue-green laser, and recently the blue laser, is a technology development effort, a technology demonstration program.

Mr. **Paisley**. I wonder if at this time we could consider closing the session, and we will go into a little more detail with you.

Can we do that?

Mr. **Price**. Can we finish the JVX first, and then we will go into a closed session.

Mr. **Paisley**. Right.

Are there any more questions on JVX?

Mr. **Hertel**. With Mr. Battista's help here—I want to be very careful. I think there are some things—and I would like to have the staff clarify that we can discuss publicly about the communication system breakthroughs.

Mr. **Battista**. There is a disagreement here, Mr. Hertel, with the Navy. First of all, we are a lot closer to a blue-green laser deployment than people would like to admit.

Admiral Baciocco was right in the sense it is not near-term, but the reason is the Navy won't fund it appropriately. You could put two satellites up within the next 3 years and they would be very, very functional, and in fact would provide far more coverage than an E-6 Tacamo.

You heard the Secretary's assessment last year. That is the first thing he would give up. That is not a Navy program. That is a national program. It is about $5 billion when you factor in the 20-year O&S costs, and it is over $2 billion without those costs factored in.

The fact is, if you had $30 million in this year, $120 million next year, and about $200 million the following year, you could have two satellites in orbit by 1990-1991, and the EAM, the emergency action message response, the capability, that would be far superior to either a Take-Charge and Move Out 130, or an E-6.

So, it is not a question of technological difficulty; it is a question of funding.

Years ago, if you remember, it competed with the Seafarer or the Sanguine or what is presently known as ELF. That is no longer the case. What it is competing with today is E-6 Tacamo.

The fact of the matter is, if you look at it from the standpoint of either performance or dollars and cents, you would get a far greater return on the investment by putting two satellites in orbit than you would going with an E-6.

Mr. Secretary, or Admiral Baciocco, if I have said something you disagree with, stand up and scream.

Admiral **Baciocco**. I will, sir, if I may. I won't scream. I will be dutifully polite.

While we are still in open session, I would like to make a few points clear for the record. Our best look at that by Admiral Clark's people in the Space and Naval Warfare Command, does not bear out the fact that simply putting two satellites up would yield a system to replace Tacamo in the near term.

First, we don't understand exactly what the system architecture requirements are and we will not until we have conducted some very important tests. I would be delighted to talk further about this in closed session.

Second, in my view, the reliability that one needs in a Tacamo-like system in my view is not there and would not be there in a satellite-based system instantly. In other words, it is not a near-term tradeoff.

Third, the technology that is necessary for such a spacecraft, to satisfy the power requirements, and produce the flexibility that is needed is just not in hand right now. The ongoing DARPA program to develop a space-qualifiable, albeit gas, laser will not be finished until 1988.

Mr. **Hertel**. How can we even talk about then going ahead as you do with the money for SDI? You are talking about something far more sophisticated, far more requirements in that area, just a thousand, millionfold more complicated, if you don't have any faith in the satellite for communication.

Admiral **Baciocco**. I didn't say I didn't have any faith in it, sir. I said at this point to commit to it as a replacement for, or a system in lieu of, our current Tacamo concept is quite premature.

Mr. **Hertel**. Is there any comparison in the abilities to communicate in your mind between the E-6 and Tacamo and the satellite system, as far as the amount of information, the comparison in communication?

Admiral **Baciocco**. I would like to answer that, if I may, in closed session, sir.

Mr. **Battista**. Admiral, if you will come back to the office, one, I will show you the architecture; two, I will give you the funding profile; three, I will give you some history that in 1981 we could have had two satellites in orbit under an Air Force program called OPSAT. In fact, it was in 1976 that I discussed the prospects with McDonnell Douglas.

We have got the technology in hand. If you people over in space warfare there are going to insist on 16 times 10 pulses in terms of the capabilities lifetime granted, you are not going to get there. But I think you have to say what is required. I am referring to the gold plating of the spec that says you will never get there.

I am very long on corporate memory on this program. I remember the guy who first wrote the article worked out at San Diego. And, by the way, they got an excellent briefing out there at Point Loma. I had read his article in the IEEE transactions indicating the capability of SLCSAT, and it wasn't too long after that that he had been transferred. That is another word for "fired." But he no longer works for the Navy.

So, there is a long history to this program that is not very comprehensive.

But, anyway, I would be glad to make all that data available to you.

Admiral **Baciocco**. I appreciate that, sir.

The engineer at the Naval Ocean Systems Center in San Diego, the one that is currently in charge of the program at the lab level is still alive and well and has been there for at least 25 years, and is a strong proponent of the program.

Mr. **Battista**. I was referring to Dr. Carpin.

While you bring that up, let me say, Mr. Secretary, I am not sure you were with Secretary Lehman, but he was given that briefing about 15 months ago, and the Secretary's question was: If we are this far along, why the hell do we need the E-6?

Were you at that meeting?

Mr. **Paisley**. No.

Mr. **Battista**. It was out in San Diego.

Mr. **Paisley**. If it was, I probably wouldn't admit it.

Mr. **Battista**. Let me just finish up on the JVX and hear a little bit of history.

Mr. **Hertel**. One second before you leave.

What will be the relationship with ELF and Tacamo into the future?

Admiral **Baciocco**. ELF, sir?

Mr. **Hertel**. Yes.

Admiral **Baciocco**. I think probably we ought to discuss that in closed session.

Mr. **Hertel**. Thank you.

Mr. **Battista**. Just a last one on the JVX, then.

General Smith, you know it was 1980 when the Marine Corps wanted the AV-8B, and the Secretary of Defense terminated it and the Congress restored the funds for it, because there was a general feeling that there was no substitute for the AV-8B in terms of your requirement for operating in the forward area. I don't think that is the case now with the V-22.

Mr. McCurdy's point about the reluctance of other services to sign up for it, it wasn't but 3 years ago that, Mr. Secretary, your principal deputy said it had lousy hovering characteristics and therefore wasn't a very good ASW platform.

In addition to that, you are trying to keep the cost down, but you are also losing performance.

Going back again 2 years, there was a general in the Air Force who wore, at that time, three stars, who has more than that today. I asked what his interest was in the JVX and why he only had $1 million in it. He said, "That is so no one will ask me to put 10 in it."

I said, "Where is it on the Air Force priority list?"

He said, "Not very high."

It appears as though you have got the only firm requirement for it right now. Now I am told that the Air Force has changed its story, and this will be their future SAR bird, search and rescue. Except, as recently as yesterday I got told they are very disenchanted with your engine selection; that it was in effect a move to keep costs down; that it does not meet their range requirement by at least 100 percent. And I thought we were developing the MTD engines specifically for the V-22.

It appears as though you have lost the Air Force as a potential customer; or, if they do buy it, they will have to redesign it right away because they stated categorically it doesn't meet their requirement.

I would like to ask if you could provide for the record what option you would exercise if the Congress took away your JVX program. Would you go to a 53?

Don't answer it now. You could provide that for the record.

[The following information was received for the record:]

MV-22 Osprey

There is no satisfactory alternative. The fundamental issue is the continued credibility of this nation's amphibious assault capability. A medium lift, vertical assault platform is central to the amphibious assault capability, and it cannot be adequately provided by any other alternative aircraft. The CH-53E is a superb heavy lift helicopter. It is not an assault helicopter since it does not possess the requisite survivability features such as ballistic tolerance and crashworthy design. The H-60, also mentioned as an alternative, does possess the survivability characteristics, but lacks the payload and range necessary for the medium assault mission. Additionally, the current H-60 would have to be marinized for shipboard compatibility. Disregarding survivability, compatibility, and capability, an alternative lift equivalent to that of the V-22 would require additional and unprogrammed personnel, amphibious ships and strategic airlift to match the V-22 capability. Overall total systems costs of this alternative is 35% more than the V-22 proposed for the Department of Defense. Efforts to develop an entirely new aircraft would cost at least four percent more than the V-22 and would not be available until 1996, a full five years after the V-22. It is clear the V-22 is both the most tactically and cost effective solution to our critical lift shortage in the 1991 timeframe.

But what alternative would you go after if Congress did not support it?

Second, what offsets would you be willing to identify in the Navy and Marine Corps to have it funded in fiscal year 1987?

If you would do that for the record, I think it would be helpful.

[The following information was received for the record:]

MV-22 Osprey

Throughout the difficult and competitive budget development process the V-22 maintained its stature as the only viable alternative for the Marine Corps amphibious assault mission. The program provides the Marine Corps with a balanced combat capability, is included in the President's Budget and therefore does not require an offset.

Mr. McCurdy. Before we go into closed session, on page 13 of your statement you have a section on RPV's. Can you expand on the Navy's program on RPV and what you expect to use it for?

Mr. Paisley. Do you want to talk about it a little bit, Dick?

Mr. Rumpf. Would you like to do it now, sir, or later?

Mr. McCurdy. Just quickly.

Mr. Paisley. We have got an awful lot of programs that are classified.

Mr. Rumpf. I have two charts. The one that sets the stage for that is a classified document.

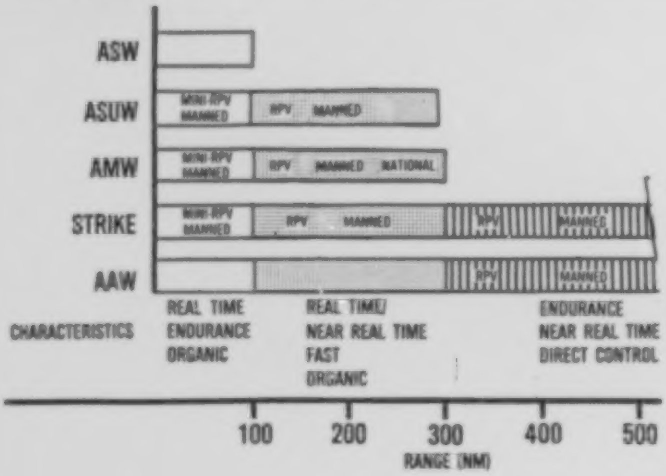
Mr. McCurdy. Do it when we are in classified, then.

Mr. Price. The subcommittee will go into executive session. All those who are not eligible to receive classified information must leave the room.

[Whereupon, at 11:10 a.m., the subcommittee proceeded in executive session.]

Mr. PRICE. The committee will resume.
You may proceed, Mr. Secretary.

## REQUIREMENTS SUMMARY



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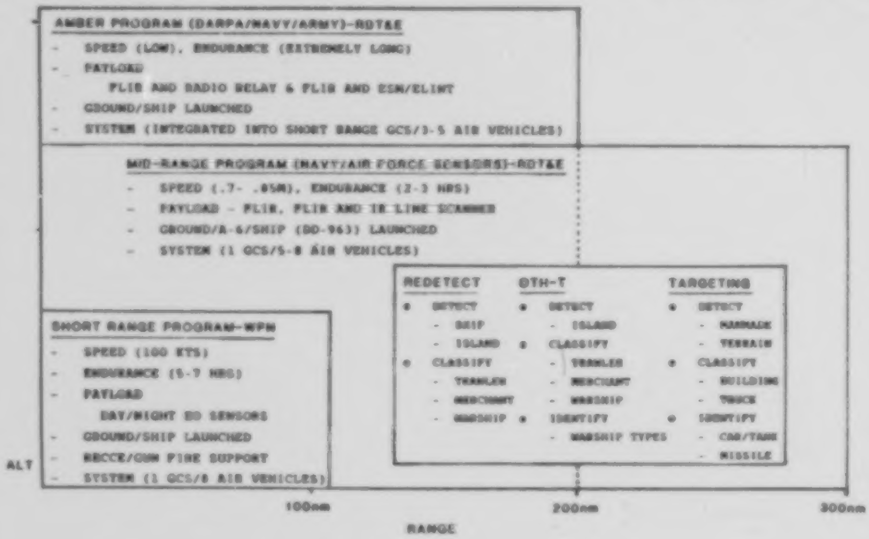
## PROGRAM CAPABILITIES



**AMBER PROGRAM (DARPA/NAVY/ARMY)-RDT&E**

- SPEED (LOW), ENDURANCE (EXTREMELY LONG)
- PAYLOAD
  FLIR AND RADIO RELAY & FLIR AND ESM/ELINT
- GROUND/SHIP LAUNCHED
- SYSTEM (INTEGRATED INTO SHORT RANGE GCS/3-5 AIR VEHICLES)

**MID-RANGE PROGRAM (NAVY/AIR FORCE SENSORS)-RDT&E**

- SPEED (.7- .85M), ENDURANCE (2-3 HRS)
- PAYLOAD - FLIR, FLIR AND IR LINE SCANNER
- GROUND/A-6/SHIP (DD-963) LAUNCHED
- SYSTEM (1 GCS/5-8 AIR VEHICLES)

**REDETECT**

- DETECT
  - SHIP
  - ISLAND
- CLASSIFY
  - TRAWLER
  - MERCHANT
  - WARSHIP

**OTH-T**

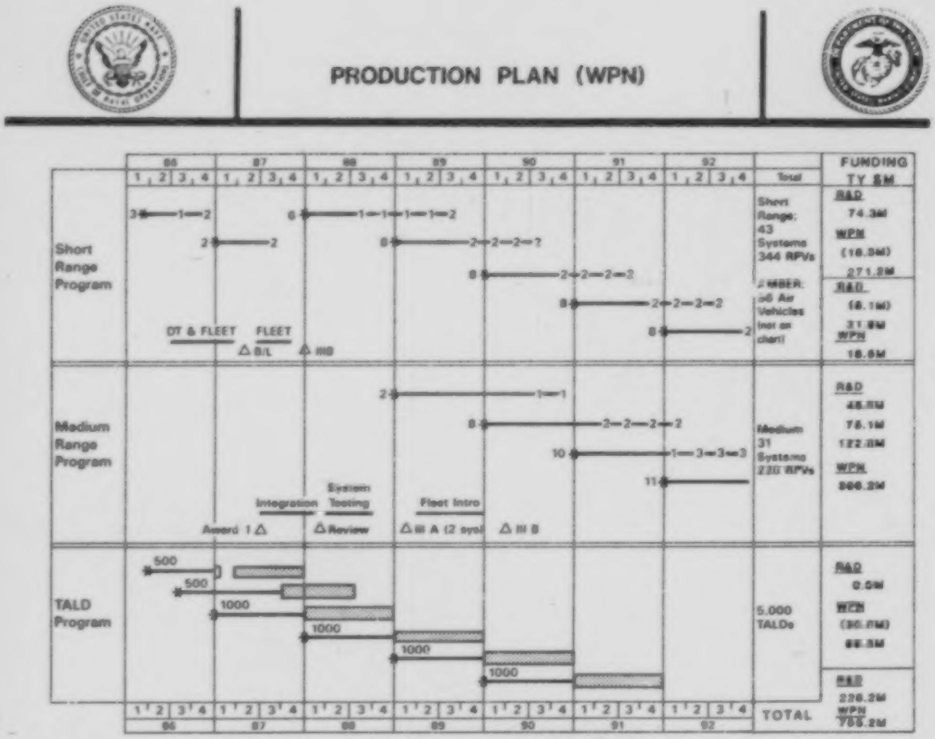
- DETECT
  - ISLAND
- CLASSIFY
  - TRAWLER
  - MERCHANT
  - WARSHIP
- IDENTIFY
  - WARSHIP TYPES

**TARGETING**

- DETECT
  - MANMADE
  - TERRAIN
- CLASSIFY
  - BUILDING
  - TRUCK
- IDENTIFY
  - CAR/TANK
  - MISSILE

**SHORT RANGE PROGRAM-WPN**

- SPEED (100 KTS)
- ENDURANCE (5-7 HRS)
- PAYLOAD
  DAY/NIGHT EO SENSORS
- GROUND/SHIP LAUNCHED
- RECCE/GUN FIRE SUPPORT
- SYSTEM (1 GCS/8 AIR VEHICLES)



PRODUCTION PLAN (WPN)

Mr. McCurdy. If you could, why don't you tell us quickly about your RPV, what you are doing there. We have the Aquila, an Army program having a little difficulty, and I would be curious what your experience is.

Mr. Rumpf. Let me show you first the requirements that we have presented to the Joint Requirements and Management Review Board, which is composed of the four star vice chiefs from each service. as you know, sir.

Laying out the various warfare fighting disciplines, we have come down to this type of matrix or road map of requirements for our RPV's. It shows that we in fact have absolute requirements in strike anti-air warfare [AAW] and in anti-surface warfare [ASUW] capability that are very well defined as well as requirements for the Marine Corps and for long-duration, high-flying national assets.

We have shown our requirements meshed with the requirements from the other two services. This is one reason why the Navy was recently given the lead in the RPV arena, other than the Aquila system for the Army at this point in time.

We are fielding a surveillance remotely piloted vehicle system right now—if I can have the next chart, please.

I direct your attention to the top line which is the short-range system. Two years ago, Captain Wise and I came to Congress and asked for reprogramming action at the time when the Marine Corps was in Lebanon, as you will recall, sir. We were granted that reprogramming permission and in fact bought one platoon worth of RPV's from the Israelis, the Mastiff system. Building that expertise and lessons learned, we went out for a competitive procurement that was recently won by AAI with a Mastiff derivative system. This is the schedule that shows the development and deployment of systems. We are talking about 43 total operational systems which can be used in contingency operations and relocated anywhere in the world within 72 hours.

Mr. McCurdy. Are they primarily surveillance?

Mr. Rumpf. These are primarily surveillance; that is correct.

Mr. McCurdy. They are not target and acquisition?

Mr. Rumpf. No; no laser designators, either.

[Deleted.]

Mr. McCurdy. Do they have stealth characteristics?

Mr. Rumpf. [Deleted.] What we have done in the 1985 time period is purchase kits for the payload on six BQM-74's, and are flying them to also do the same sort of tactic development as we did with the Mastiff system to understand what our operational requirements are over what we call the medium-range, high-speed RPV system. This plan leads to acquiring a system that looks very much like a target drone system. This medium-range, high-speed system has a modular head on the front end of a target propulsion system. We can take that surveillance kit and store it at Sigonella, for example, in the Mediterranean. If we need to fly off of a ship in the same way we launch targets today, the system can fly overland, perform a photo reconnaissance mission, either have direct communications back if it is in line of sight or remotely relay data back to the ship via aircraft if the RPV flies over the horizon from the launching ship. We are in this demonstration and tactics development phase now with competition coming up, as you can see, in fiscal year 1987. We plan to award a contract to proceed with a system that would ultimately develop 31 systems with 220 vehicles again building off of commonality with our target system so that we are not reinventing the wheel.

In the MOU that we have with the Air Force it is their responsibility to develop the sensor suits, the low-cost sensor suits.

This line shows the tactical air launched decoy system which is also part of this overall program. We are learning from lessons in Lebanon. We had a competition in which Brunswick and now an Israeli/McDonnell Douglas team are competing against each other for the very low-cost decoys which we also use.

Mr. McCurdy. Propeller-driven?

Mr. Rumpf. No, these are free flight, just glide-type vehicles, no propulsion in them.

Mr. McCurdy. All of them?

Mr. Rumpf. All of these decoys here.

Mr. McCurdy. The decoys?

Mr. Rumpf. The short-range system is propeller driven. We are fielding a system right now that has 7 hours of flight duration, can fly about 15,000 feet maximum——

Mr. McCurdy. Recoverable?

Mr. Rumpf. Yes, recoverable. All of these are recoverable.

Mr. McCurdy. A net on a ship?

Mr. Rumpf. No; at the present time these short-range systems are recovered on land or on LPH, LHA type ships.

[Deleted.]

This would be an ideal platform, or an LHA or an LPH. We can land these short-range RPV's on an LPH or LHA today. A very low-cost system that looks very much like a cable on a carrier is put across the deck. It is easily picked up and moved. I have videotapes that I didn't bring with me, to show that capability.

Mr. McCURDY. What is your cost on these things?

Mr. RUMPF. I am trying to think of the latest cost. Bill, do you remember?

Mr. SCHAEFER. The cost of the initial units being delivered in the short-range competition is about 300 K per unit. [Deleted.]

Mr. HERTEL. I would like to go back to the discussion we had about TACAMO and laser satellite communication. What can you tell us now as to the progress you have made?

Admiral BACIOCCO. Yes, sir, if I may. ELF, as you know, is a broadcast system that gives us the ability to maintain continuous communication to any of our submarines at depth and at speed, or in other words, through the majority of the operating envelope. With a system other than ELF, a submarine is required, if you are to have continuous communication with it, to have an antenna above the surface, or on the surface, or just below the surface. We use trailing wire antennas or buoys for that, and in both cases the submarine is generally, albeit deep, at relatively slow speeds. ELF obviates that. It is a broadcast system. As you would do at home, you listen to the radio, everyone is listening to everything that is broadcast, and when you hear something of interest, you concentrate on that.

A submarine broadcast system works the same way.

The E-6A is a system which is part of our strategic architecture. It is a SIOP system. Its purpose is to assure delivery of emergency action messages to submarines. Our strategic submarines, which are in an alert status, have the necessary antennas near the surface and are in constant communication, receiving messages. They will receive that message if not by another means, most assuredly by TACAMO. It is a reliable system. It is there to assure, in the final degree, that those messages do get through.

SLCSAT technology is a program, as I have said, which has been around for a relatively long time and is making some very good progress. Three years ago we renewed a memorandum of understanding with DARPA and did some redirection of the program, because a couple of things had happened. Up to that time, the program was exploring lasers at blue-green wavelengths. The National Academy of Science's Naval Studies Board Space Panel and the Naval Research Advisory Committee, looking at that program among others, noted that there had been some breakthroughs in cesium atomic resonance filters and in the xenon chloride laser. These components transmit and receive in the blue wavelengths and had far more capability at far less required power to penetrate great depths of water.

We redirected the program at that time to concentrate on blue lasers. DARPA went to a single contractor to develop a space qualifiable laser design and that is ongoing by one of our Nation's aerospace contractors. This effort is to be completed, with the contractor providing a set of class 2 drawings, at the end of fiscal year 1987.

We recognize that a satellite-based system will be expensive. Therefore, we said if it were a system to be used only for communicating with strategic submarines, it probably is not cost effective. As noted before, we have in place a variety of methods to communicate with strategic submarines. ELF is a bellringer, one which passes, albeit slowly, a lot of data, and TACAMO which is a redundant system for EAM injection. We said if we are going to have it, and it looks promising, it ought to be capable of communicating with all of our submarines, wherever they are. Therefore, since our SSN's [deleted] and operate as part of their wartime missions [deleted] we ought to be satisfield that the system will work [deleted]. For the last 3 years we have been working on that.

We have a blue-green laser mounted in an airplane which will fly to the Arctic this spring. [Deleted.]

We have a blue laser, the first blue laser, scheduled for testing [deleted].

Mr. **Hertel.** Why is it moved back [deleted].

Admiral **Baciocco.** Because it is an [deleted] exercise, and getting all the resources together, the submarine, the aircraft, the people out on [deleted] stations, it is very complex and expensive. When we go [deleted], we try to accomplish a great deal while we are there, for example, weapons tests, sensor tests, and in this case a blue laser test. We have been working on an SLCSAT concept of operations, and requirements, so that we could go to a program start when we have all that data in hand. That doesn't mean that we wait [deleted] to program our dollars, but it does mean that we don't go programming dollars without understanding that we can, in fact, have reliable communications wherever our submarines would be.

We hope all of this will work out. I personally happen to be a supporter of this program. However, it is not a de facto replacement for TACAMO. In my view as a submariner, SLCSAT does not have the survivability that we have with TACAMO. The TACAMO injection is very reliable, as proven in exercises all the time and, as I said, it is a broadcast system.

Mr. **Hertel.** What about vulnerabilities in comparison?

Admiral **Baciocco.** I believe SLCSAT has greater vulnerability. For example, the two satellite constellations being proposed by one contractor that Mr. Battista mentioned, would be in [deleted] orbits. Although the Navy has not yet evaluated this concept, it appears that if one of those satellites goes down, you don't have sufficient coverage remaining. In any case, SLCSAT is controlled from a ground station, and that ground station is vulnerable.

In contrast, we have more than one TACAMO aircraft. We have [deleted] for those. They fly. They can move. They are hard to find. Predicting where those satellites are going to be and the location of the ground station would be relatively easy, if someone were bent on putting a vital segment of your strategic connectivity system out of action at a critical time in an escalating crisis.

Mr. **Davis.** Will the gentleman yield?

Mr. **Hertel.** Yes.

Mr. **Davis.** Thank you.

As I understand it, the Navy's position at least a few years ago was that they really wanted, and the way I am hearing you today, Admiral, is that you do support three systems, ELF system, a space-based laser system, and the TACAMO system. Is that still the Navy's position, that they would like three communications systems to our submarine fleet?

Admiral **Baciocco**. I would feel very comfortable in emphasizing and reiterating that we support ELF and TACAMO very strongly. I don't think we have yet demonstrated to our leadership, to the Secretary, or to ourselves, the fact that it is worth the expenditure to put blue lasers in space to communicate with submarines.

If money were not the consideration, I would say yes, SLCSAT would be a very useful system to have, and I would support it personally.

Mr. **Hertel**. That is what I wanted to get into the discussion before. I always err on the side of being careful, which is why I asked the staff and why I certainly agreed to go into closed session. This public magazine, Defense Science and Electronics, discusses in far more detail than we have had so far the comparison between the system, and that has been out in publication before the public. I have no objection to talk about this in public except the point which you just said what the priorities are. You are giving us cause to believe that the satellite system isn't progressing as well as some of us have been briefed, and that it is not a priority, because money is the issue. It seems to me that if we look at the systems, the one thing that hasn't been discussed in detail is the superior communication with the satellite system.

Can you talk to every sub, as you mentioned, any time, any place, [deleted] around the entire world, instantaneously, and send far more information—you can send any amount of information, as compared to what you would have under TACAMO. There is no comparison in communication, is there, as far as abilities?

Admiral **Baciocco**. That range of capabilities has not been demonstrated. For instance, sir [deleted] there are four distinct seasons. [Deleted.]

[Deleted] we should not commit billions of dollars until we are satisfied that we have collected the data, [deleted].

Mr. **Hertel**. If your tests bear that out, it would be far superior as far as the places you could communicate and the information you could communicate. There would be no comparison to TACAMO, ELF, with regard to communication?

Admiral **Baciocco**. If dollars were not a concern, one might——

Mr. **Hertel**. We can agree that it appears that the laser is cheaper than TACAMO, can't we?

Admiral **Baciocco**. No, sir, not at all. The laser is but not the system.

Mr. **Hertel**. Not the system?

Admiral **Baciocco**. No, sir.

Mr. **Hertel**. The figures that we have seen——

Mr. **Battista**. Cost is a consideration, and certainly when you look at the 20-year O&S costs and even the initial up-front costs on the E-6, there is no comparison. I am looking at data now indicating that over a 20-year lifetime having to put six satellites in orbit is around $2.5 billion. If we were to take your O&S costs for 15 E-6s and throw on the up-front costs, which are between $1.2 and $2 billion, you come up with almost $6 billion.

Now you talk about communicating [deleted]. By the way, I would be glad to give you all of the calculations that we ran here, for your review, but you talk about, well, we haven't demonstrated its ability to communicate [deleted]. We have got lots of laboratory data on that, and there seems to be a double standard. For example, on the Trident program we committed to the entire Trident program before we ever had our first firing. We did that for Polaris. We did that for Poseidon.

Admiral **Baciocco**. We did that for Polaris, I agree. We did not do it for Poseidon or Trident. We committed with the experience of Polaris behind us.

Mr. **Battista**. We had expended—and I will get the right numbers for you, the exact numbers—several billion dollars before we had the first of the 13 Trident firings, way back when.

In addition to that, you have got strong laboratory data here to support not only the megabit data rate on the blue-green, [deleted]—but the fact is with the current level of funding and the level of funding that has been attached to this program, those answers are always going to be out in the future.

Admiral **Baciocco**. Mr. Battista, the current level of funding was established three years ago, in concert with DARPA and ourselves, to make a sensible program to get to the earliest point where one would want to commit money for a development program. We have communicated with the blue-green laser from a T-39 aircraft to the Dolphin, AGSS-555, off San Diego [deleted]. We have done tests off Coos Bay, OR, and demonstrated [deleted]. We are now getting calibrated for our spring tests [deleted]. We have communicated with the [deleted] with a blue-green laser in a P-3 at relatively low altitude in the clear waters off Hawaii.

We know that light transmits through water. SLCSAT is a great step, though not without significant risk. Our best space people tell us that the systems architecture will be quite complex. We must design an operational control system that will allow us to spot-cast to submarines, not knowing to a large degree of certainty where they are in such a manner that you retain OPSEC so as not to disclose where those submarines are, and with the same assurance of message delivery that we presently have in our broadcast systems.

I personally am a supporter of SLCSAT. I am not a supporter of going out and doing something foolish with the limited resources we have, and my boss on my right would never let me do it.

Mr. **Hertel**. Wait a minute, I don't think we are talking about anything foolish here. We are talking about priorities and our future.

Admiral **Baciocco**. Yes sir.

Mr. **Hertel**. And we are talking about what I believe and I think we can all agree is our most important defense, and that is our Trident submarines, which I have always been a strong supporter of and even tried to get accelerated.

Admiral **Baciocco**. Absolutely.

Mr. **Hertel**. No. 2, to have all that money spent on that very important defense, the next question is to communicate with them.

Admiral **Baciocco**. Yes, sire.

Mr. **Hertel**. We have spent hundreds of billions of dollars here on different things and we are talking about billions with the Trident fleet. Then to spend $2.5 billion, if Mr. Battista is right, on the total program is not outrageous. If, as we agree, we have made great progress in the last 2 years and we talk about the 3-year funding set, that is something that we have been discussing right now that has been dramatic.

Mr. BATTISTA. One other point, too. All of the data that the Admiral talks about that was collected over the past year and half was predicted back in 1979 and 1980. [deleted.] The models are very good in terms of being able to predict the performance of this system.

The other point I would like to make is you are making it a binary comparison. You are saying this versus TACAMO.

Mr. HERTEL. That is my problem.

Mr. BATTISTA. That is not the case.

Mr. HERTEL. That is my problem, because if we can see the testing going on and making progress. I agree with Mr. Davis, at worst if we have to we should go with all three, but you are saying an either/or thing with TACAMO because of the limited funding, and I am talking about I think we can agree, especially from your viewpoint also, national security in communicating in the best possible way under any circumstances with our submarines. We are not talking about when we talk about a $300 billion defense budget, this amount of money is not outrageous to talk about as we put in last year additional funding.

Mr. BATTISTA. $10 million last year, but again, Mr. Hertel, it is not a question of this versus TACAMO. You have got TACAMO, you own EC-130 TACAMO aircraft, and by the way, you get better activity with the EC-130's [deleted] than you do with the E6. That is Navy data. The point of contention is what should the next generation be. Should it be E-6A's or should it be SLCSAT's or should it be a combination of the two. So it is not a comparison of SLCSAT versus TACAMO, because you already own that capability.

Admiral BACIOCCO. No sir, but it was presented at least as an implied comparison between SLCSAT and the E6A, Tacamo.

Mr. BATTISTA. That is a valid comparison.

Mr. HERTEL. I think you have to because you are talking about communication.

Admiral BACIOCCO. It is not clear at all. I feel very confortable and the Department of the Navy feels very comfortable with the maturity of the E6A in the TACAMO role, and with the communications equipment that we will put in our E6A's.

Mr. BATTISTA. That is because you have a mod program [deleted]. You say it is somewhat without risk. I am not too sure you have solved the [deleted] problem yet. I mean, it certainly was touchy when it was tested.

Admiral BACIOCCO. We feel very confident that if there is risk, it is extremely low. I cannot honestly say the same thing about the risk associated with a SLCSAT carrying out a TACAMO-like mission.

Mr. HERTEL. You think TACAMO is also going to have that lower amount of risk into the future?

Admiral BACIOCCO. Yes, sir, I do. There is little risk in upgrading TACAMO as need be, with planned improvements. I am talking about the E6A as it will deploy through the mid-90's. I am sure there will be [deleted] equipment that we might put in it. We are certainly going to put [deleted] into it. I think that is all relatively low risk, or at least would be by the time we get there.

Mr. HERTEL. All I want to say is I want to work with you. I am excited about it, and it has always been a priority of mine, and I guess we will find out. Considering that we have adequate funding that I think this subcommittee is going to be committed to that we can go ahead with the testing and find answers out very definitely in the shortest amount of time.

In addition, let me say, I just received this article 15 minutes ago. If there are things in here that are classified that should not be out in the open, I would be happy to work with you in any way to stop information that is going out in regard to this or any other program. I think we can agree that communication in this area is one of our top, if not the top, priorities strategically.

Mr. DAVIS. Let me add to that. I take a little bit different position, I think, than maybe Tony does. I think we should go ahead with SLCSAT. I do think the Navy has probably not concentrated, spent as much money on R&D as they should, but I am very much in favor of going ahead with TACAMO, with the E-6A, in improving that system.

Some time ago I took the position we ought to go ahead with SLCSAT and not go ahead with the ELF system. That is behind us now. The ELF system is in fact, just the second ELF system is just about ready to come on line, so that is kind of behind us. But I do think that we ought to have three systems, if the satellite system is viable, and I guess I think it is. We ought to go ahead with three systems.

The ELF system is going to be on line very shortly. I think we are going to test the new facility out [deleted].

I do have one question about the ELF system. I have forgotten, I may have known at one time [Deleted.]

Admiral BACIOCCO. Sir, I can answer that in a general way. [Deleted.]

**Mr. PRICE. Mr. Battista, any questions?**

Mr. BATTISTA. Just one on a related matter.

Admiral, you said you didn't want to do something foolish. Yet we look at the ASCL, the P3 receiver for the sonar buoy. [Deleted.] You are less than [deleted] right now. You have got EMI problems, you have got sensitivity problems. You have got module receipting problems. It was supposed to cost $65,000 a copy with the antenna. It is now $480,000 without the antenna. It has been in development for 10 years and it is in procurement now. Could you go back and have a look at that, because I will tell you, I had a phone call from an unidentified former naval officer who said, "I am going to Jack Anderson with it."

I said, "Would you hold off for 30 days and we will ask Secretary Paisley and Admiral Baciocco to look into it." There are apparently two other companies. They both build receivers for the S3. They work fine, but something is going awry with this thing. If you could take a look at that.

Admiral BACIOCCO. Yes, sir, we will look into that. I think we are coming back later this week to talk to you about that subject.

Mr. PRICE. Thank you very much, gentleman, for your cooperation.

The committee will recess until 2 o'clock.

[Whereupon, at 11:45 p.m., the subcommittee recessed to 2 p.m. of the same day.]

## AFTERNOON SESSION

Mr. PRICE. The subcommittee will be in order.

Mr. Paisley, why don't you start where you left off this morning.

Mr. PAISLEY. We are going to start off with Mr. John Keane. He is going to cover the SUBACS Program, the SSN-21 and our mine development program. John.

## STATEMENT OF JOHN J. KEANE, DIRECTOR, ASW PROGRAMS

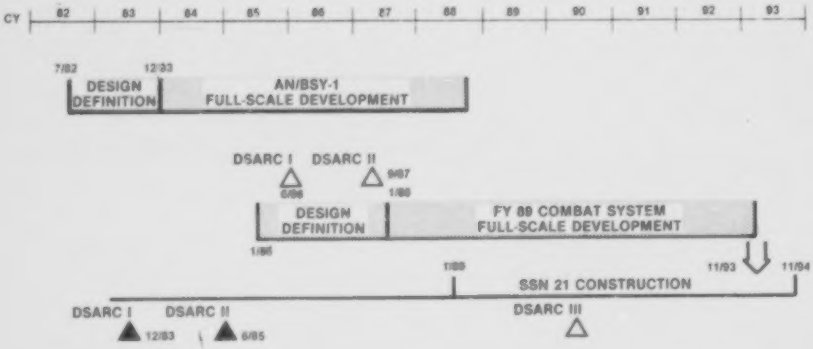
Mr. KEANE. Mr. Chairman, I would like to begin by saying that we have successfully accomplished the milestones that were set forth in the congressional language on the SUBACS Program. As you know, we have had some difficulties in the past with this program. As a result of those difficulties, we restructured the program, and you may remember we used to have a three-phase SUBACS Basic, SUBACS A and B. We currently have two phases to it. One is designated the AN BSY-1, which is the old SUBACS Basic, or BSY-1, and then the other phase of the program is the fiscal year 1989 combat system. This is the system which will go on the SSN-21.

Treating the problems we had in the past, I would say we could categorize those into one of three types. One was a Navy management problem. We did not have focused attention or the personnel applied to the program that it warranted. We have since corrected that. We have restructured the Navy organization, and we have a flag rank officer totally dedicated to the combat system. He has a staff now of adequate personnel to support that program.

The second problem we had was within the contractor's facility, and it centered around the technicalities of the fiberoptic data bus. As you probably recall, it was the fiberoptic based network operating system that was the key to the SUBACS Basic design. That was an immature design as far as architecture goes. What we have done since then is to restructure the operating system around a computer-controlled architecture, which is a much more readily achievable software solution.

Third, we had a hardware problem within SUBACS, centered around the multilayer ceramic boards that were included in the network operating system. We had a process problem there with the vendor. We have subsequently overcome that. We are getting throughput adequate to support the program right now, so I think we have taken the three basic problems that we basically had, and have managed them to the point where the risk is minimal.

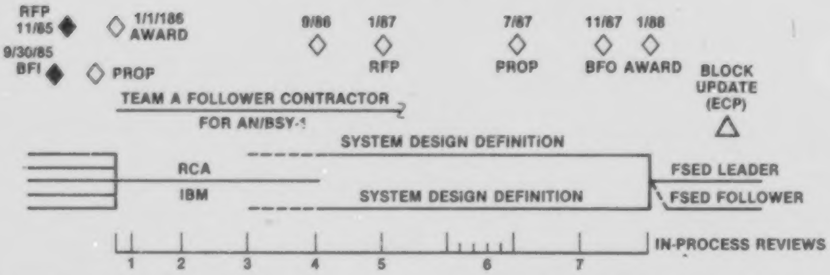
## AN/BSY-1 AND FY 89 COMBAT SYSTEM SCHEDULES



I would like to put up the slide now, and show that we have, as I said, a two-phase program, the BSY-1, on the top line there. We are well along in full-scale development. We have brought on competition as instructed by the congressional language. We have currently a team of RCA and G.E. in competition with IBM, and they are injected into the BSY-1 Program as a learning process, to get up to speed so that they can compete for those AN/BSY-1 ship sets. In addition, that provides them a learning process to get involved in the second phase of the program, the fiscal year 1989 combat system. They and IBM will be in competition designing their own fiscal year 1989 combat system for about 2 years, at which time we will then down select to one leader and one follower, for the full-scale engineering development.

**Details of this are shown on the next Vu-Graph.**

## ACQUISITION STRATEGY



REQUEST FOR PROPOSALS (OCT 1985)

- AN/BSY-1 FOLLOWER CONTRACTOR
  - STATEMENT OF WORK
- FY 89 COMBAT SYSTEM — SYSTEM DESIGN DEFINITION
  - LIMIT GOVERNMENT LIABILITY
  - DETAILED STATEMENT OF WORK
  - INTERFACE CONTROL DRAWINGS
  - A SPEC
  - CONCEPT OF OPERATIONS
  - "NAVY RESERVES RIGHT TO MODIFY BASELINE"

SDD SOURCE SELECTION (DEC 1985)

- BASED ON
  - COMBAT CONTROL/ACOUSTIC EXPERIENCE
  - TEAM CORPORATE COMMITMENT
    - FOR FOLLOWER EFFORTS
    - FOR SYSTEM DESIGN DEFINITION
  - MANAGEMENT PLAN
  - RESOURCES
  - ORGANIZATION
  - PRICE

This is a little busy, but basically we have the BSY-1 activity along the topline, and the RCA/IBM team working together to generate an A spec in this time regime and then they split apart and each of them designs their own system which they then compete, and in January 1988 we select a leader and a follower. The leader and follower teams take the program through FSED, and at the end of FSED we than compete again for production ship sets between the leader and follower, so we maintain competition through the entire program.

I guess that is what I have to say on SUBACS. Are there any questions?

Mr. Bayer. What is the funding profile associated with this program now? Where is it funded in the P.E. items?

Mr. Keane. I think the Admiral would like to answer that.

Admiral Baciocco. I am sorry, I didn't hear the question.

Mr. Bayer. What is the funding profile on this restructured program for 1987 and out years?

Admiral Baciocco. The BSY-1, $203.2 million in our fiscal year 1987 request. With 1988, $135.8 million R&D.

Mr. Keane. One thing I failed to mention was that the BSY-1 contract and development has been capped at the budget that we have had for it in accordance with the congressional language. It not only has been capped, but there have been penalties for schedule delays imposed on that contract as well.

Admiral Baciocco. If I may, the SSN-21 combat system profile, just so you have it complete, for 1987 is $113.5 million, and for 1988, $141.5 million.

Mr. Bayer. That is for the combat system?

Admiral Baciocco. Yes, sir.

Mr. BAYER. What program elements are those in the BSY-1 and the SSN-21? Why don't you just provide that?

Admiral BACIOCCO. I will provide that.

Mr. BAYER. If you would, please.

Admiral BACIOCCO. For the record, yes, sir.

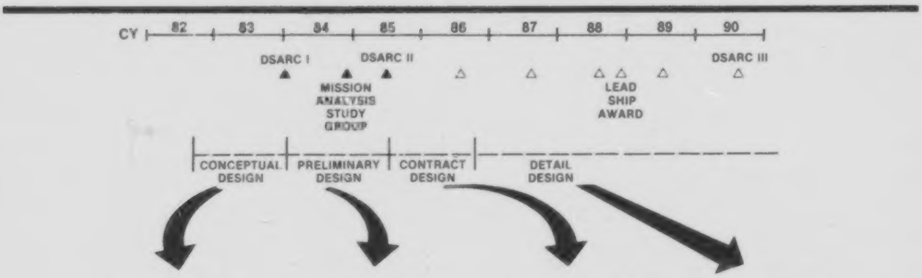
[The following information was received for the record.]

The Submarine Combat System-BASIC (AN/BSY-1) and the SSN-21 Combat System projects are contained within the Submarine Combat Systems (Development) program element, 64524N.

Mr. KEANE. We will go into the SSN-21 construction. It would like to put up the next Vu-Graph. [Deleted.] As you know, this is a formidable task, with an effort to develop the most advanced attack submarine in the world. It will have a far greater tactical speed than anything we have, or the Soviets. Its weapon capacity is almost twice what we have currently. It has got a tremendous increase in sonar capability, and its own quieting.

As you may recall, in the early phase of the development of this, we went through a design iteration and tradeoff, one of which got quite a bit of publicity, and had to do with the bow arrangement. I would like the next Vu-Graph.

SSN 21 DESIGN PROCESS IS ON SCHEDULE



- BASIC CHARACTERISTICS ESTABLISHED

- CONFIRMATION OF
  - SIZE
  - WEIGHT
  - COST
- TOP LEVEL REQUIREMENTS ESTABLISHED
- BASELINE DESIGN FOR COMPETITION

- SHIP BUILDING SPECIFICATION
- CONTRACT DRAWINGS
- BASIS FOR DETAIL DESIGN COMPETITION

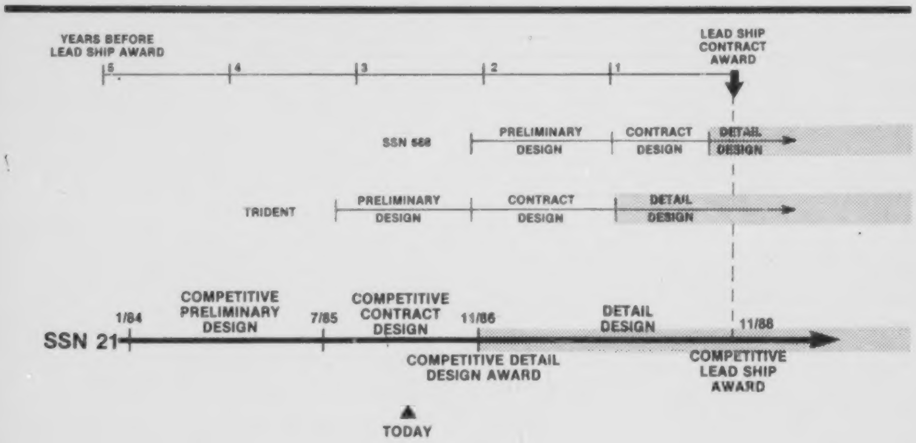
- DETAIL DESIGN DRAWINGS
- BASIS FOR LEAD SHIP COMPETITION

During the early preliminary design activity, which transcended 1984 and 1985, there was a desire to have the weapon launching from the bow, because of concern about [deleted] its effect on the ship. Heretofore, we have tubes coming out the side of the ship, and we launch at a relatively low speed. For this ship with its tactical speed advantage, there was a concern to get the weapon launch points up in the deadwater space of the ship, and we traded off a number of designs and actually ran some experiments with a 688-class ship [deleted].

That helped develop the top-level requirements and established the baseline design.

We then this past year got into contract design with those shipyards who are currently working to the end of this year, at which time we expect to award a detail design leader contract as well as a follower contract.

SSN 21 DESIGN SCHEDULE ON TRACK



The next Vu-Graph shows that we are spending a considerable amount more time on detail design than we have with the Trident or the 688. I think that is a lesson learned. We think we need that in order to adequately address all the technical issues and the cost issues of this ship. That is a basic summary of where we are today.

Mr. DICKINSON. I got in late. You might have covered this. But did you give a program and a unit cost for this series of submarines?

Mr. KEANE. We are still targeting for $1.6 billion for the first unit down to $1.1 billion by the fifth ship.

The results of the preliminary contract design support those cost estimation figures.

Mr. DICKINSON. And what does that include? Everything but the missiles?

Mr. KEANE. Yes, and other weapons, sir.

Mr. DICKINSON. Will it necessitate any military construction or other capital investments of that nature?

Admiral BACIOCCO. No, sir.

Mr. KEANE. Will the ship require that? No, sir.

Mr. DICKINSON. We can berth it within harbors and everything that is in being now will be adequate for just the followon submarine?

Mr. KEANE. Yes, sir.

Mr. DICKINSON. Mr. Battista.

Mr. BATTISTA. Talking about the total system here, I had to talk to Mr. Dickinson for a minute. How much more capable now is the SUBACS without the Star bus, seeing as how you had to abandon that concept, than what you have got on the 688.

Mr. **Keane**. As you remember, the optical data bus was really the first phase of the three-phase SUBACS development loading to the 21, at which time one expected to be able to add features to the 21's that were not even in conception at that point. That was the real key to why we went to the optical data bus, so for the basic or BYS-1 combat system, there is no operability or performance degrading of any kind because of the computer control architecture.

Mr. **Battista**. What I am saying is we are spending an awful lot of money with IBM right now. How much more capable as a weapon controls system is it than the present 688? Is it worth the investment?

Mr. **Keane**. Yes; absolutely. I don't know how to put it in terms of how much more capable. Maybe the Admiral will want to answer.

Admiral **Baciocco**. You will recall, sir, that SUBACS Basic, now the BSY-1 had as the primary increases in capability over the current BQQ-5, acoustic detection subsystem, an advanced active sonar, the SADS, the Mine Detection Avoidance [deleted] Sonar, MIDAS, the TBX thin line towed array, and the processing power of TRIAS versus the UYS-1. The capability that was planned for SUBACS Basic with regard to top-level specifications and the capability we will achieve with the BSY-1 are identical. It is the SSN-21 combat system, previously SUBACS B, where the operability improvements are the focus of the development.

Mr. **Battista**. When you look at the bottom line in a constrained environment, will the 21 still be an acceptable platform if we had to rely on the current BQQ-5?

Admiral **Baciocco**. The SSN-21?

Mr. **Battista**. Yes.

Admiral **Baciocco**. No, sir; I don't believe so. In fact, I know so. It will not.

Mr. **Keane**. It couldn't handle the acoustics system, for one.

Admiral **Baciocco**. That is right. The Wide-Aperture Array, the increased firepower that we will have—and as a matter of fact——

Mr. **Battista**. So, you absolutely need the SUBACS.

The second question is, You are not hooked into the contractor who has had a less than sterling performance on this. You now have competition in the form of Sperry and RCA?

Admiral **Baciocco**. RCA and G.E. I think we have a very strong competitive plan as well as a strong competitive team there, who not only will be competing for the design and development of the SSN-21 combat system, but also for production of the SUBACS Basic systems for all of the SSN-688's.

Mr. **Battista**. And at what platform will we be able to realize the competition?

Mr. **Keane**. The first SSN-21, and also according to their proposal, the fiscal year 1988 BSY-1 systems.

Mr. **Battista**. You remember that the subcommittee support or this committee's support for the 21 was contingent upon your running a parallel advance submarine technology program. How much money do you have in the budget for that this year?

Admiral **Baciocco**. In submarine R&D lines, which address specifically beyond the SSN-21, we have a total of about $59-$60 million.

Mr. BATTISTA. Admiral, I discussed this with you. I just want to put it on the record, and I discussed it with Mr. Dickinson. The concern is, you know, we were far too long in staying with the 688. This is a mission whose time was here about 5 years ago, and Mr. Secretary, I don't think you have seen these photos yet. This is an open literature abstract of a Soviet publication on the makeup of the tissue of the Dolphin, the skin of the Dolphin.

[Deleted.]

We are relying on people whose defense budgets are, you know, only a fraction of ours to get critical information, and I will give you these photographs. I showed them to Admiral Baciocco and I want to send a copy over to Admiral Demars.

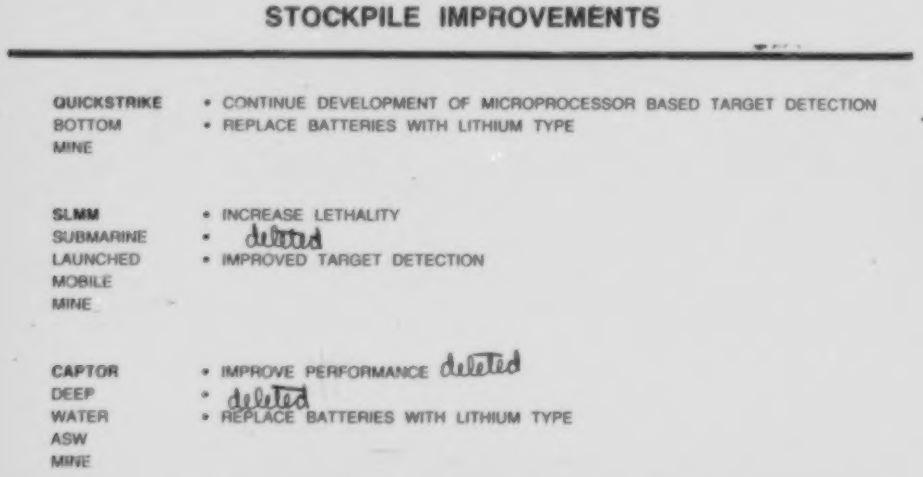
[Deleted.]

Admiral, do you want to comment?

Admiral BACIOCCO. We are, as a result of previous discussions with you and members of the committee, ensuring that we have [deleted] priorities that are clear, and that will go after some of the same material that you obtained [deleted].

Mr. DICKINSON. Did you have another topic?

Mr. KEANE. I have one more topic, yes; in the mine warfare area. Over this past year we have had a significant achievement in completing a rather exhaustive study on mine warfare requirements. As a beginning to this study, we sort of wiped the slate clean and decided to look at mine warfare through the maritime strategy, to develop what mine warfare requirements we would need in the future. We took a number of areas of the world that the warfare strategy would dictate, looked at the environmental conditions and the quantity of mines necessary in those areas to conduct mine warfare, developed about 61 candidate mine designs that would satisfy that requirement, condensed those down to about six generic types, which I will show on the next Vu-Graph [deleted]. These six generic types then were looked at with respect to our current inventory, [deleted].

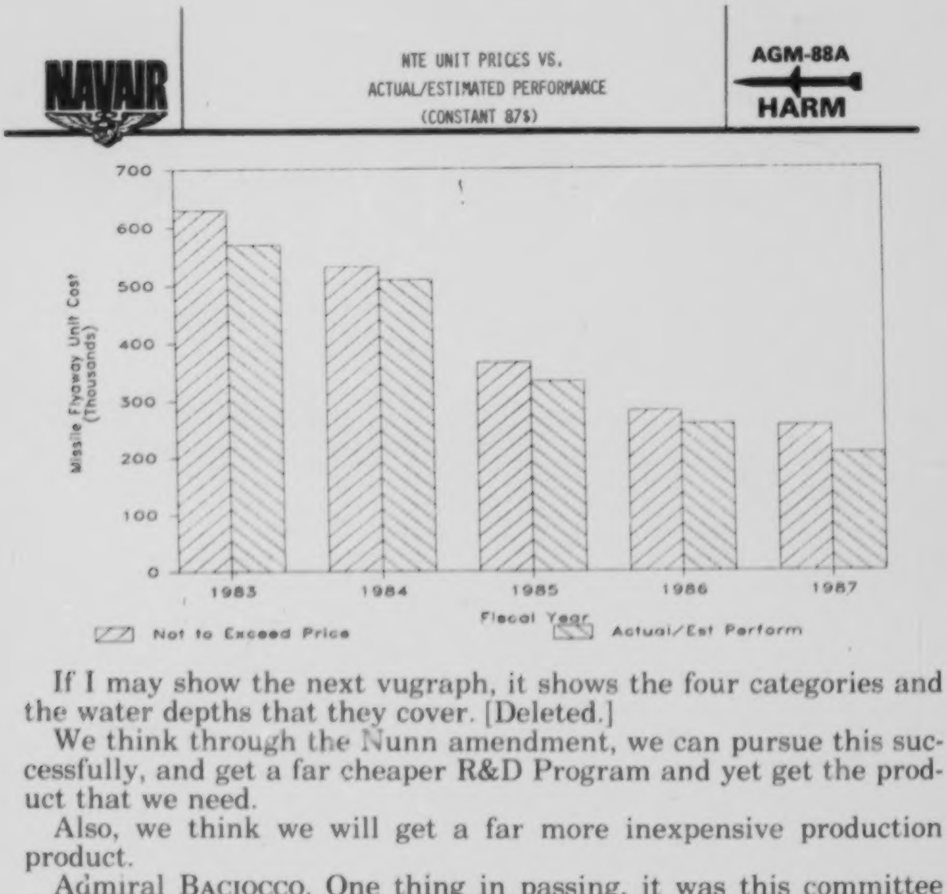


STOCKPILE IMPROVEMENTS

| | |
|---|---|
| QUICKSTRIKE BOTTOM MINE | • CONTINUE DEVELOPMENT OF MICROPROCESSOR BASED TARGET DETECTION<br>• REPLACE BATTERIES WITH LITHIUM TYPE |
| SLMM SUBMARINE LAUNCHED MOBILE MINE | • INCREASE LETHALITY<br>• deleted<br>• IMPROVED TARGET DETECTION |
| CAPTOR DEEP WATER ASW MINE | • IMPROVE PERFORMANCE deleted<br>• deleted<br>• REPLACE BATTERIES WITH LITHIUM TYPE |

If we go about upgrading the inventory in two major areas they are shown in the next Vu-Graph——[deleted]. Looking at the Quick

Straight, the Slim and the Captor, [deleted] these three mines would satisfy all but one requirement from that study. The one requirement dictates a need for a new mine which we call the attack sea mine. [Deleted] and with that mine and these three upgraded, we would have a war-fighting strategy and capability that we need for the year 2000.



If I may show the next vugraph, it shows the four categories and the water depths that they cover. [Deleted.]

We think through the Nunn amendment, we can pursue this successfully, and get a far cheaper R&D Program and yet get the product that we need.

Also, we think we will get a far more inexpensive production product.

Admiral BACIOCCO. One thing in passing, it was this committee that has kept the pressure on the Navy for a viable mine program and a hard look at mine warfare. I can say, seeing the output of the 2 years of effort which you encouraged us to take part in, and seeing the opportunity here to develop this attack sea mine, and the momentum it has right now, I am more encouraged than I have been in years as to the interest and dedication for really giving ourselves a family of mines that will enhance our capability tremendously at a reasonable cost.

Mr. DICKINSON. Could you describe some of the characteristics that we can expect this mine to have? What will it do?

Admiral BACIOCCO. Yes, sir. John, why don't you go back to the previous slide that you showed before.

It is a mine that would be used in [deleted.]

[Deleted.]

Mr. DICKINSON. Would it be anchored or actually on the bottom?

Admiral BACIOCCO. [Deleted.] That, of course, will be traded off as we get concepts in from industry, [deleted]. It would have a set of sensors to detect a submarine. We have, as a result of the last 2 years' efforts, tested a series of sensors that might show promise for this. [Deleted.]

Mr. KEANE. [Deleted.]

Admiral BACIOCCO. [Deleted] of course as we work [deleted] we will trade off cost and capability to get a mine that meets both of our requirements in a satisfactory manner.

Mr. DICKINSON. This [deleted] is triggered by what?

Admiral BACIOCCO. It is triggered by the passing of a ship, a submarine.

Mr. DICKINSON. Pressure, sound, what?

Admiral BACIOCCO. [Deleted.] You will set up a logic that says I need this combination of signals, and I want to count ships, and I won't go off until the third ship goes by. It depends on where the field is and what you design that field to do.

[Deleted.]

Mr. DICKINSON. And you can set it, then, to select from a flotilla or a fleet of ships, [deleted].

Admiral BACIOCCO. It is primarily targeted against submarines, but [deleted] you could give it some selectivity, yes, sir.

Mr. DICKINSON. What would be the deployed life of this mine?

Admiral BACIOCCO. Our specification right now for the deployed life [deleted.]

Mr. DICKINSON. I have in mind the occasion when the United States swept the Suez Canal and the approaches. The Soviets offered to do it, but the Egyptians said, "Thank you, we will go with the United States." In such an event, how do you turn these things off? How do you collect them if you have seeded an area with mines, and then the events pass and you don't want the area mined anymore; how do you recover them?

Admiral BACIOCCO. You wouldn't recover them really. You would know when you put them in, what the programmed life expectancy of the mine was, and at the end of that time you would sweep them, remove them. Otherwise you could go through with a mine countermeasure ship or a minesweeper and in fact activate the mine. A wise designer, though, would design something into the mine that only you knew, [deleted].

Mr. DICKINSON. The same would be true of the MX but they say we can't do that because it might compromise the whole fleet. [Deleted.] Maybe that doesn't pertain here. What are we talking about in unit costs?

Admiral BACIOCCO. $200,000 as a top limit, [deleted].

Mr. DICKINSON. We keep talking about the British. Are we working [deleted] on this or what?

Admiral BACIOCCO. One of the competitors [deleted].

Mr. DICKINSON. Is this in conjunction with an American firm?

Admiral BACIOCCO. Yes, sir [deleted].

Mr. BATTISTA. You did trigger a thought, Mr. Keane, and that is on the surface ship torpedo defense system—this is another one, admiral that the committee has had an interest in for about the past 8 years running. Now we understand that you are getting on with the program, [deleted].

Mr. PAISLEY. We are not going to do that.

Mr. BATTISTA. Isn't that right?

Admiral BACIOCCO. No, sir, that is not right. We have taken a vry hard look at that program. We have had, as you know, a considerable amount of effort going into what we think to be a priority component of it, [deleted]. We asked the Naval Studies Board, of the National Academy of Sciences, to take an objective look, with their knowledge of the technology, and their knowledge of the threat, at what we were doing and be an adviser to us. They have come back and said, one, you should concentrate on detecting the torpedo. Now, we have recently run some tests of the USS *Kennedy* [deleted]. We launched torpedoes against the ship, to see if we could detect them. We detected them all. In fact, we got surprisingly good results, much better than we had predicted.

Mr. DICKINSON. Once you detect a submarine, what is the counter?

Admiral BACIOCCO. [Deleted.]

In past years, as people have been trying to defeat torpedoes and thinking about hard kill weapons their solutions have always been too complex. Such early concepts generally [deleted] tried to lay a weapon on the torpedo [deleted]. That is a very difficult and complex task, as you know. What we now think we can do [deleted].

[Deleted.] We don't know the best method yet [deleted]. That is very important on our capital ships. [Deleted.]

Mr. BATTISTA. The Falklands taught us that you get a Third World country [deleted].

Admiral BACIOCCO. Yes.

Mr. BATTISTA. So what you are really saying here is you are going to have the equivalent of an onboard component, and that you will have both a detection capability and pretty soon a hard target kill capability?

Admiral BACIOCCO. A detection capability, [deleted] followed by a hard target kill. Yes, sir, that is correct.

Mr. PAISLEY. I think, Tony, looking at this thing, we spent a lot of time on it, that we have got a good program laid out now. The tough part is the very last one. It is not vastly different [deleted].

Yes, you can [deleted] but that is a very expensive proposition and difficult. I am not convinced that we are going to be able to do the last one of these, but maybe if you can isolate the area you have to operate [deleted] maybe you can do it, but that is the program now. I think for the first time looks pretty good. [Deleted.]

With that, if there are no more questions, at this time I would like to have Dick Rumpf come up and talk about several of our programs, the A6 improvement, the low-cost seeker for the HARM.

Mr. DICKINSON. Before you do that—and we are interested in this—we certainly want to get it for the record if the Members aren't here. It has been announced by radio that President Marcos is air-borne now. We don't know where he is going. There is a meeting on this floor at 3 o'clock, a Members-only briefing, by the State Department, to bring us up to date, and I think that those Members who might be here, including myself, would like to go and get that. I don't know what your schedule is and how flexible you are at coming back. But that only gives us 7 minutes. I am not suggesting, Mr. Rumpf, you do your whole dog-and-pony show in 7 minutes. I am telling you some of the problems we have, and I am open to whatever suggestions you make.

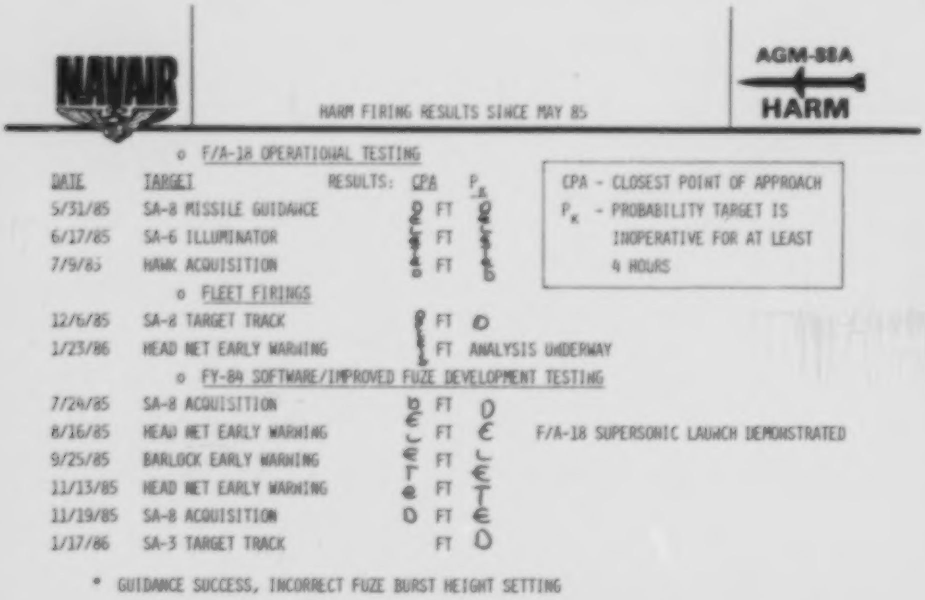
Mr. PAISLEY. We can reschedule and come back. I think the most difficult part of that is your schedule, not ours, because we plan on this time of year to do this, and the number of days left to do it is not that large.

Mr. **Darden**. Mr. Chairman, may I say I concur with your announced situation. I believe this presentation is an especially important part that I would like to be present at. I think actually we need to have more Members present, so if it is possible I would like to postpone this to another time.

Mr. **Dickinson**. I would be glad to accede to whatever request the gentleman would make. At Mr. Battista's suggestion, cover the HARM, and then we will recess or adjourn so that we can go hear the briefing on what the State Department can tell us. Actually, I think we would do better listening to the radio than listening to a State Department briefing, but anyway we have to do things in a different way. Probably you did not know this, but the radio reports that President Marcos is airborne, going someplace with whatever retinue he has with him. Take a fast and low run at this thing, and we will come back to it later, because as Mr. Darden says, I think it is very important. We ought to have more Members here for it. We will reschedule.

## STATEMENT OF RICHARD L. RUMPF, PRINCIPAL DEPUTY ASSISTANT SECRETARY FOR RESEARCH, ENGINEERING AND SYSTEMS, DEPARTMENT OF THE NAVY

Mr. **Rumpf**. All right, Mr. Dickinson. Thank you, sir.


NAVAIR

HARM FIRING RESULTS SINCE MAY 85

AGM-88A HARM

CPA - CLOSEST POINT OF APPROACH

$P_K$ - PROBABILITY TARGET IS INOPERATIVE FOR AT LEAST 4 HOURS

o F/A-18 OPERATIONAL TESTING

| DATE | TARGET | RESULTS: CPA | $P_K$ | |
|---|---|---|---|---|
| 5/31/85 | SA-8 MISSILE GUIDANCE | Deleted FT | Deleted | |
| 6/17/85 | SA-6 ILLUMINATOR | FT | | |
| 7/9/85 | HAWK ACQUISITION | FT | | |

o FLEET FIRINGS

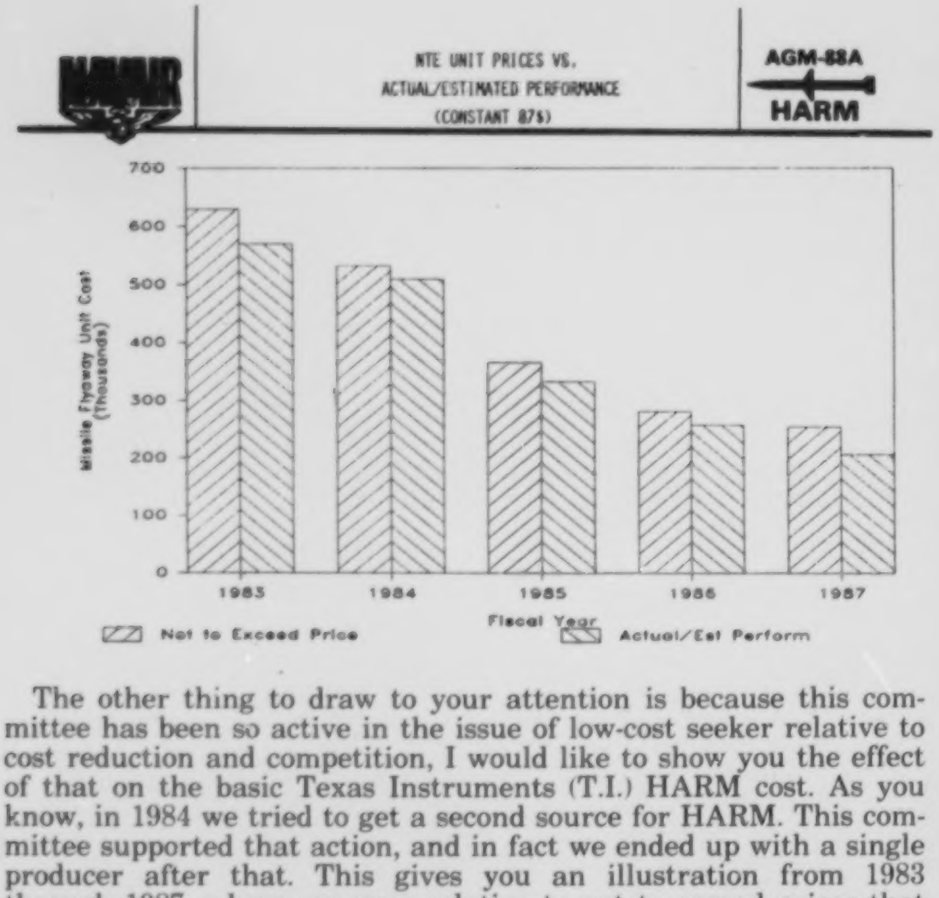
| DATE | TARGET | RESULTS: CPA | $P_K$ | |
|---|---|---|---|---|
| 12/6/85 | SA-8 TARGET TRACK | Deleted FT | D | |
| 1/23/86 | HEAD NET EARLY WARNING | FT | ANALYSIS UNDERWAY | |

o FY-84 SOFTWARE/IMPROVED FUZE DEVELOPMENT TESTING

| DATE | TARGET | RESULTS: CPA | $P_K$ | |
|---|---|---|---|---|
| 7/24/85 | SA-8 ACQUISITION | DELETED FT | DELETED | |
| 8/16/85 | HEAD NET EARLY WARNING | FT | | F/A-18 SUPERSONIC LAUNCH DEMONSTRATED |
| 9/25/85 | BARLOCK EARLY WARNING | FT | | |
| 11/13/85 | HEAD NET EARLY WARNING | FT | | |
| 11/19/85 | SA-8 ACQUISITION | FT | | |
| 1/17/86 | SA-3 TARGET TRACK | FT | | |

* GUIDANCE SUCCESS, INCORRECT FUZE BURST HEIGHT SETTING

First, I am happy to report to you, since the last time I briefed this committee a year ago, where various issues were raised, that we have had some outstanding success in the HARM program. We are now 12 for 12 with the shot that is not listed here but was fired last week. The 1984 software, which was to be tested since my testimony here last year sir, has now had a run of six complete successes, and if you will notice, these are the closest points of approach, all within lethal radius of the warhead and rated as very high probability of kill ($P_k$), [deleted]. We have had a very good test program with live firings using the new software, and have shown that the predictions we made last year were correct.



The other thing to draw to your attention is because this committee has been so active in the issue of low-cost seeker relative to cost reduction and competition, I would like to show you the effect of that on the basic Texas Instruments (T.I.) HARM cost. As you know, in 1984 we tried to get a second source for HARM. This committee supported that action, and in fact we ended up with a single producer after that. This gives you an illustration from 1983 through 1987, where we were relative to not to exceed prices that we got from the contractor, and where we settled on the prices that we negotiated down. As Mr. Paisley mentioned to you earlier, we have not paid, even in this program, for a price at the not-to-exceed level.

We are paying in $255,000 per flyaway missile in the 1986 contract. Now, that is on a buy of about 2,600 rounds.

For the buys in 1987, 1988, and 1989, we are considering a multiyear contract to further reduce that cost, still based on the roll forward of not to exceed prices. We always add 2 years of not to exceeds to any contract we negotiate.

Mr. DICKINSON. It will be 2 years?

Mr. RUMPF. The multiyear would be 3 years, but what I am saying to you is that we have not to exceeds, that roll forward 2 years ahead of each buy-year that we have in the arrangement. This gives you an illustration of the real effect of competition without direct competition on this program, thanks to the great work of this committee in staying steadfast on the low-cost Seeker program.

Mr. DICKINSON. That is what you call micromanagement?

Mr. RUMPF. I wouldn't say so, sir.

One other thing to report to you. In addiiton to the fact that the Secretary of the Navy and the Secretary of the Air Force have certified the HARM program, last year your committee was instrumental in the Navy performing a teardown and an audit on a missile right off the line.

HARM NAC AUDIT

Conducted 23 Apr–17 Jul 85 at request of Mr. Paisley.

Joint Air Force/Navy Team—60 personnel headed by NAC.

Conclusions:

No hardware/software changes that would degrade missile performance.

Flight test results show no performance degradation throughout development and operational testing.

Credit not given to increasing difficulty of test shots over time.

Some factory test equipment problems.

Software management plan not effectively applied.

Software support activity at NWC not fully functional.

Advanced threats will require software updates.

This basically summarizes for you the conclusions of that audit, and while minor things were discovered, and even large numbers of minor things in the fabrication of the system, there were no showstoppers, and we are progressing with a fix at the contractor for all those minor items, so that future HARM's do not experience that same kind of minor problem. Nevertheless, no deficiencies discovered were showstoppers in terms of operational capability.

Mr. DICKINSON. Mr. Battista has a question. We have had serious problems, perturbations in the program, with the prime, T.I., and you say no serious things that would be show-stoppers. Mr. Battista has a question.

Mr. BATTISTA. The record in both performance and price has not been very good. We had to bail them out on SHRIKE. You had on your chart the original prices here, and we are still paying too much for some of those components. Now there is a move afoot, as I understand it, within the Navy to get an upgrade program back to T.I. In fact, in the last year, we have been fighting, getting the low-cost Seeker shipped out to T.I. Now we have got a competition which is great. You have got Raytheon and Ford now competing, but very honestly, Mr. Secretary, with your program now for contractor facilitization, these guys are not going to be able to compete for initial lots of even the low-cost Seeker, and I think you are going to have to make some kind of a special exemption here, if you really want competition in this program, because frankly we are lucky. You have got the best capability in the world, I think, at China Lake, but we have got to get those smarts out to other folks in the industry. But I am told that this HARM 4 thing is really over at NavAir, and I think they are going to take you two folks to the cleaners as well as the Congress and the taxpayer unless you folks intervene. Do you know about this, by the way?

**Mr. PAISLEY. Dick, tell them where that is.**

Mr. RUMPF. The NavAir people are examining a Block 4 Product Improvement with T.I. and other government labs. China Lake, the Applied Physics Laboratory, and NAC in Indianapolis are examining what is called a Block 4 System, which I generically call a low-cost Seeker that T.I. has proposed. This proposal would impact, in their view, the fiscal year 1989 buy.

That system has been paid for by T.I., with no Government money whatsoever. It is only a proposal being evaluated for its technical merits and its cost benefit. It is in fact a very real proposal, as you have said, which is presently at the Naval Air Systems Command for evaluation.

Mr. BATTISTA. Don't say we didn't pay for it. We paid for it when we gave them $700,000 for those $255,000-a-copy missiles. We have been paying for it. We are paying for it dearly, and if we go back to those folks we are going to pay for it again many times over.

Mr. PAISLEY. I think the biggest problem, Tony, with what T.I. is talking about is, as you know, the strong support I got for the low-cost Seeker with the Secretary was not only for HARM, but that it had capability to be used in other missiles. That capability would not exist in the low cost Seeker as provided by T.I. I would not entertain T.I. competing with these other two contractors, and having them pay, facilitize themselves, and not take this into account on a bid, because we facilitized T.I.. So I have no desire to do them any favor.

I have had problems on this program. The program is starting to get healthy, but that doesn't mean that it just got there. We have had lots of trouble on this program all along from T.I. They will not slip this low-cost Seeker on us, and outbid those contractors based on the fact that they do not have to facilitize.

Mr. DICKINSON. Two things that I would like to mention just as a broad question. Thank you. We are going to continue this later.

Yesterday I had the privilege of visiting one of our major contractors. It was Sikorsky in Connecticut. the president of the company there mentioned—and it makes sense—that they have reduced, by going to multiyear, they have reduced the cost to the Government, the cost of production, and also their margin of profit. They have done this in hopes of selling more units, and in the past—I forgot the number of years; I think it is 6 years though—they have absorbed the inflation, and are selling the Sikorsky on a flat line, approximately no more than 2 or 3 percent in the past 6 years. Talking about the Blackhawk or the CH-53 or whatever, it is within that.

They are concerned, however, that now under Gramm-Rudman, or the defense budget as proposed, that they were able to do this and effect these savings of a substantial amount by multiyear contracting, and now they are faced with having their multiyear contracts terminated or varied substantially.

I know you have to be aware of this. Do you have any thoughts on this?

Mr. PAISLEY. Yes, a couple or three thoughts. One, when Gramm-Rudman came along, the Department of Defense asked the Navy, we want to isolate some programs, what do you want to do.

We didn't have to look at any programs. We merely said all fixed-price contracts will be isolated.

Mr. DICKINSON. You did that?

Mr. PAISLEY. We did that.

Mr. DICKINSON. The Air Force didn't. They eliminated, what was it, the HH60.

Mr. PAISLEY. Absolutely. We wouldn't do that. We never touched one of our fixed-price contracts. You can't write a fixed-price contract and go do that to a contractor and expect him to hold his price.

Mr. DICKINSON. I agree with you.

Mr. PAISLEY. There is one other thing. In the case of Sikorsky it doesn't apply, because it is a multiyear competed program. If you have two contractors, like we do on JVX and like we do on the engine and so forth, it is very clear from all the data I have looked at that competition every year will pay you more than multiyear, and you can't multiyear if you are going to compete every year. Competition every year between two contractors is much better than multiyear. If you only have one contractor, multiyear is a very good thing.

Mr. DICKINSON. Let me ask you this, and I have got to go. But why can't you have both? You have got a multiyear with a leader-follower, and just like Pratt and GE engines, they come in each year and they make their bid. Whoever comes in low, they get 60 percent, the others get 40 percent. If it is there, they never give you any credit for it when they give you the multiyear price.

You are in the business; I am not.

Mr. PAISLEY. We learn a lot from each other, though, you and I.

Mr. DICKINSON. Not only that, but the morale of the work force. You get some stability there. They say, "Well, I am signed up, I have got a job for 3 years. As long as we are building these things, I am in pretty good shape."

One final thing before I leave. I have been pushing the idea, and I have asked the other service Secretaries and I want to ask you about the efficacy and the benefits of going to a 2-year budget cycle in Defense. I can see no negatives. I can see a million positives. I can see money savings, in addition to which we have put burdens on the Congress and deadlines and wickets to go through that we can't meet, and if we can have one set of hearings at the beginning of each Congress, and pass a budget for a 2-year period, we can still have control of the second year. Many States do this. What is your attitude?

Mr. PAISLEY. My attitude is it is right on. You won't get a uniform opinion like that in the Navy when you get into the Comptroller's circles. They talk in a language that is difficult for me to understand.

Mr. DICKINSON. OMB is not so happy about it, either.

Mr. PAISLEY. Simple logic says, of course, to do it and therefore it must be good. I have totally supported it. I have never done anything about it.

Mr. DICKINSON. That is the problem. We have to deal here with common sense. That is tough. Do you want to put anything else in the record?

Let us reschedule the balance of this.

Mr. PAISLEY. We will do that.

Mr. DICKINSON. I think it is very important and I would like more members to be here to hear it. I am going to find out if Mr. Marcos is coming to the District of Columbia or someplace else.

Mr. PAISLEY. I think he is going to Alabama, I heard.

Mr. **Dickinson**. That is all right, if he brings his money with him. We will find a place for him.

[Discussion off the record.]

Mr. **Dickinson**. Thank you very much, Mr. Secretary.

[Whereupon, at 3:10 p.m., the subcommittee adjourned.]

# AIR FORCE FISCAL YEAR 1987 BUDGET

House of Representatives,
Committee on Armed Services,
Research and Development Subcommittee,
*Washington, DC, Wednesday, February 26, 1986.*

The subcommittee met, pursuant to call, at 10 a.m., in room 2212, Rayburn House Office Building, Hon. George (Buddy) Darden presiding.

## STATEMENT OF HON. GEORGE (BUDDY) DARDEN, A REPRESENTATIVE FROM GEORGIA

Mr. Darden. The subcommittee will come to order.

Today, the subcommittee will review the Department of Defense request for authorization for $17.3 billion for the fiscal year 1987 Air Force Research, Development Test and Evaluation Program.

Our principal witnesses this morning will be the Honorable Thomas E. Cooper, Assistant Secretary of the Air Force, Research, Development and Logistics, accompanied by Lt. Gen. Bernard P. Randolph, Deputy Chief of Staff, Research, Development and Acquisition.

The Air Force request for fiscal year 1987 represents a 41.2 percent increase over the amount appropriated last year, and there is little doubt that the request will be significantly altered.

Whether we like it or not, we have an unacceptable Federal deficit, and at a time when the Congress is considering a no-growth defense budget, there is little likelihood that a research and development account will be increased by 41 percent.

Also, we have had little success in the past in asking the witnesses how this budget request can be reduced, and frankly, I don't anticipate very much success in that area this morning when it comes to establishing which items are highest priority.

Accordingly, though, we will carefully consider the presentation this morning, and at the time of mark-up, the subcommittee will have to make some independent judgments.

While this is certainly not the best way to proceed, in the absence of establishment of priorities in from the Secretary of Defense, I think it is the only way we can move forward.

Dr. Cooper and General Randolph, it is a pleasure to have you back with us, and I ask that you proceed at this time.

## STATEMENTS OF HON. THOMAS E. COOPER, ASSISTANT SECRETARY OF THE AIR FORCE, RESEARCH, DEVELOPMENT AND LOGISTICS AND LT. GEN. BERNARD P. RANDOLPH, USAF, DEPUTY CHIEF OF STAFF, RESEARCH, DEVELOPMENT AND ACQUISITION

Dr. Cooper. We have a rather lengthy statement for the record.

In the interest of time, I am going to dispense with my opening remarks this morning and turn it over to General Randolph, who will give you an overview of our budget request.

General RANDOLPH. I would like to stand up and use some charts, if I may? I appreciate the opportunity to present an overview presentation of the Air Force budget.

I also would like to point out to the committee, that the Air Force certainly appreciates your support in the past. During the course of the discussion this morning, I would like to point out some of the things we have done to help improve the Air Force.

## FY 1987 AIR FORCE BUDGET PRIORITIES

FY 87 priorities reflect commitment to "stay on course" and continue addressing improvements most vital to combat capability

- Modernize strategic forces (offensive and defensive)
- Improve readiness and sustainability of general purpose forces
- Increase airlift capability
- Modernize and expand tactical forces

and

- Improve ability to operate efficiently and effectively in space

This chart talks to the budget priorities that we work, too.

In the area of modernizing strategic forces, the B-1B will achieve its initial operational capability in September of this year and the Peacekeeper missile will achieve its operational capability in December of this year. So we are moving forward on the modernization as planned.

It is our proposal to stay on that course as we said several years ago. In the area of improved readiness and sustainability, there has been a 44-percent improvement in the in-commission rate of our tactical fighters since 1980, and so today, 85 percent of our tactical fighters are in commission and ready to go; and that includes the older airplanes, as well as the new modern F-16's and F-15's.

It is a significant step forward in the area of readiness.

Dr. COOPER. I was recently out at Hill Air Force Base in Utah, where we have a wing of F-16's, and the mission capable rate on the day I was there was 90.5 percent. That is not atypical, and with some of the press that we received that the Air Force, and indeed the Department of Defense, is not in a ready state, I think that fact is contradicted.

Mr. DARDEN. What type of aircraft was it?

Dr. **Cooper**. F-16's. And with the F-15's, we are at about 80 percent.

Mr. Darden, 6 or 8 years ago, there was a point in time when we were lucky to get 50 percent readiness with some of our tactical fighters, so the spare's pipeline has filled and we are definitely starting to see the results of that.

Mr. **Battista**. There is no doubt you have come a long way, but on the readiness and sustainability, the problem is not with the aircraft, but is on load out of air-to-air missiles where we have got real shortfalls.

The aircraft can perform, but to send them out there with one or less load out of air-to-air missiles is not the way we are going to be able to sustain a threat.

Dr. **Cooper**. We need to continue to pay attention to that, and I would urge the committee to pay attention to that. We don't want to get back on the slippery slope we were on before.

In the IR missiles, we are in pretty good shape there. We are addressing that, and we will get into the special topic of AMRAAM later, but in that area, we need to pay attention to the radar-guided missiles.

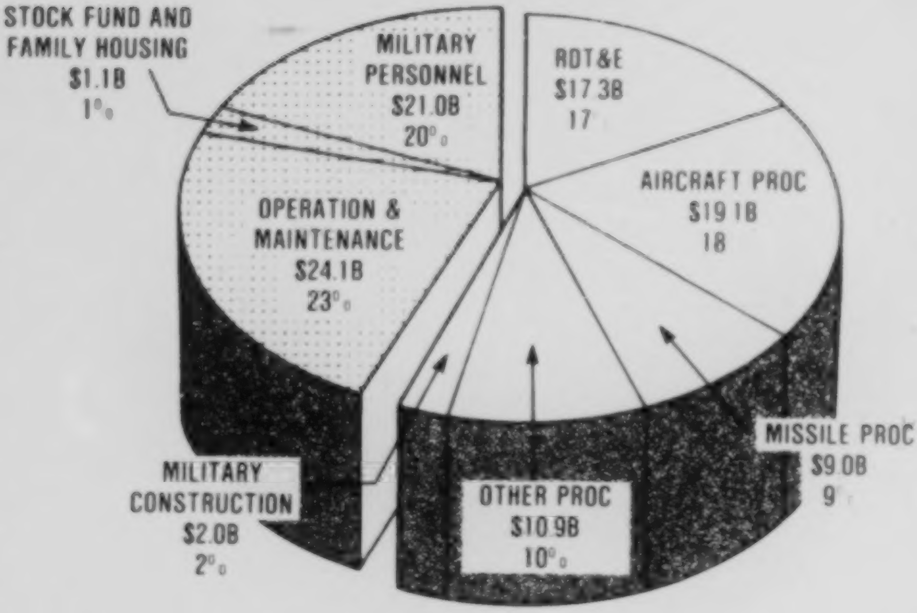
General **Randolph**. In the priority addressing increased airlift, we just delivered the first C-5B, and this calendar year we will have nine C-5B's on line.

The F-16C, which, as you will recall, has considerable improvements in its avionics package. The first operational capability came on line in October of last year. So we are continuing to work in the modernization area. In the world of space, with the support of this committee, the Consolidated Space Operations Center facilities have been completed, and the first spacecraft is now being controlled from that facility as of January of this calendar year.

So we are making some real strides in achieving the kinds of priorities that we have in mind.

**USAF FISCAL YEAR 1987 BUDGET REQUEST BY APPROPRIATION**

**TOTAL: $104.5B**



That costs a lot of money, and that is what we are here to discuss today. Our request is $104.5 billion, and before I discuss that, Mr. Chairman, I will have to admit in all candor, that I have some difficulty understanding what $104.5 billion really means.

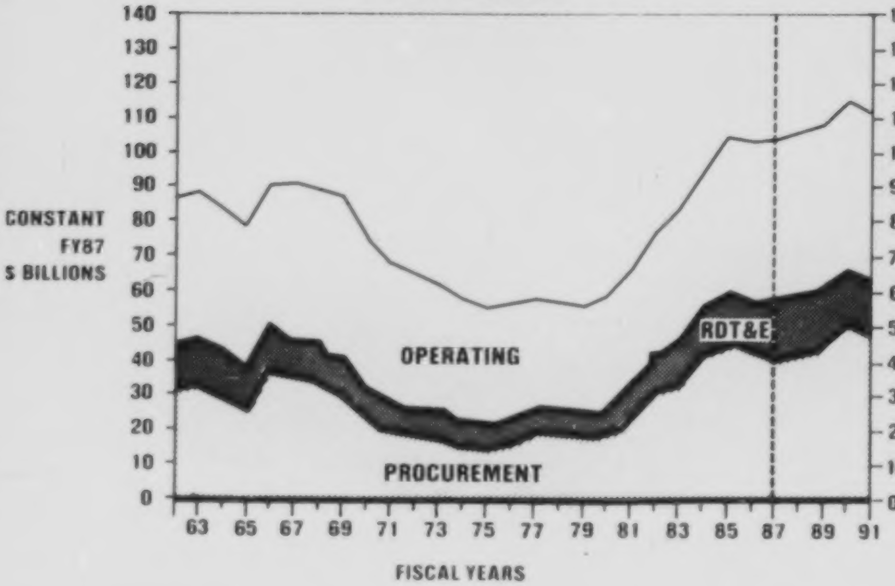
How do we put that in context, because none of us ever sees $104 billion. I put that in the context of my family budget, and I did some checking, and I said to myself, how does that work?

Well, it turns out that the Federal Government, all of the moneys that are appropriated, spends about $3 billion a day. That is for all the activities of the Federal Government.

If you put the $104 billion in that context, that is 35 days' worth of budget, so for whatever it means, at least in the context of my personal finances, that is about a month's worth of my yearly taxes.

Otherwise, I don't even understand that kind of money, because it is so huge. That, in my view, is the price of peace. That is the sort of thing we have got to do to continue to maintain a strong Air Force, and we are presenting to you the kinds of prudent things to do in terms of maintaining that strong Air Force.

You see the investment budget and also the operating budget, and I will talk about that split between operating and investment. In the investment budget, we include, military construction, and in the operating budget, we include military personnel.



USAF FY87 BUDGET REQUEST
APPROPRIATION

The thing that we are interested in is in the right balance. As you can see, in the next chart, for the past several years that balance is about the same, that is, about 55 percent in the investment area and 45 percent in the operating area.

Some folks try to ascribe a number, that is, you should have a certain percent in operating and investment. You need to take a look at the forces you have, the situation that exists and work that balance.

Let me give you an example of why we believe we have the right balance. Last year, we achieved an accident rate of 1.49 accidents per 100,000 flying hours.

Now, that is a remarkable rate. The lowest we have ever achieved in the entire history of the U.S. Air Force, and why is that? Because we had modern equipment, good maintenance, trained people, the spares that we needed, and we had the flying hours that the pilots needed in order to fly safely.

So we believe that is an example of why this balance makes sense.

Dr. COOPER. On that point, our previous low, as far as accident rates were concerned, was 1.72 in the year before last. Last year, we went back up to about 1.8. It is unheard of to go to 1.5.

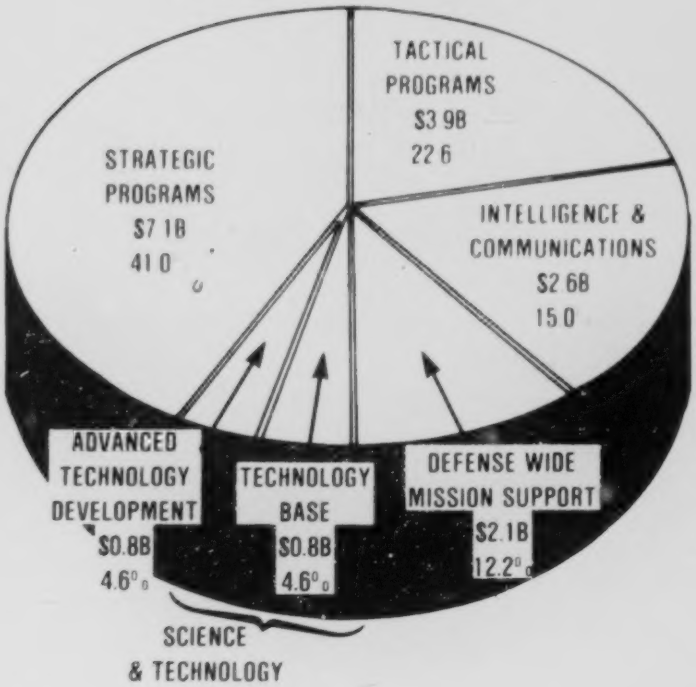
A few years ago, people would have told you you were crazy for getting below 2 with the way we train by flying under realistic conditions.

We are getting somewhere between 19 and 20 flying hours a month for our tactical fighter pilots.

General RANDOLPH. You are interested in the RDT&E budget, and I will focus on that budget now.

# RDT&E USAF FISCAL YEAR 1987 BUDGET REQUEST BY MISSION AREA

TOTAL: $ 17.3 BILLION

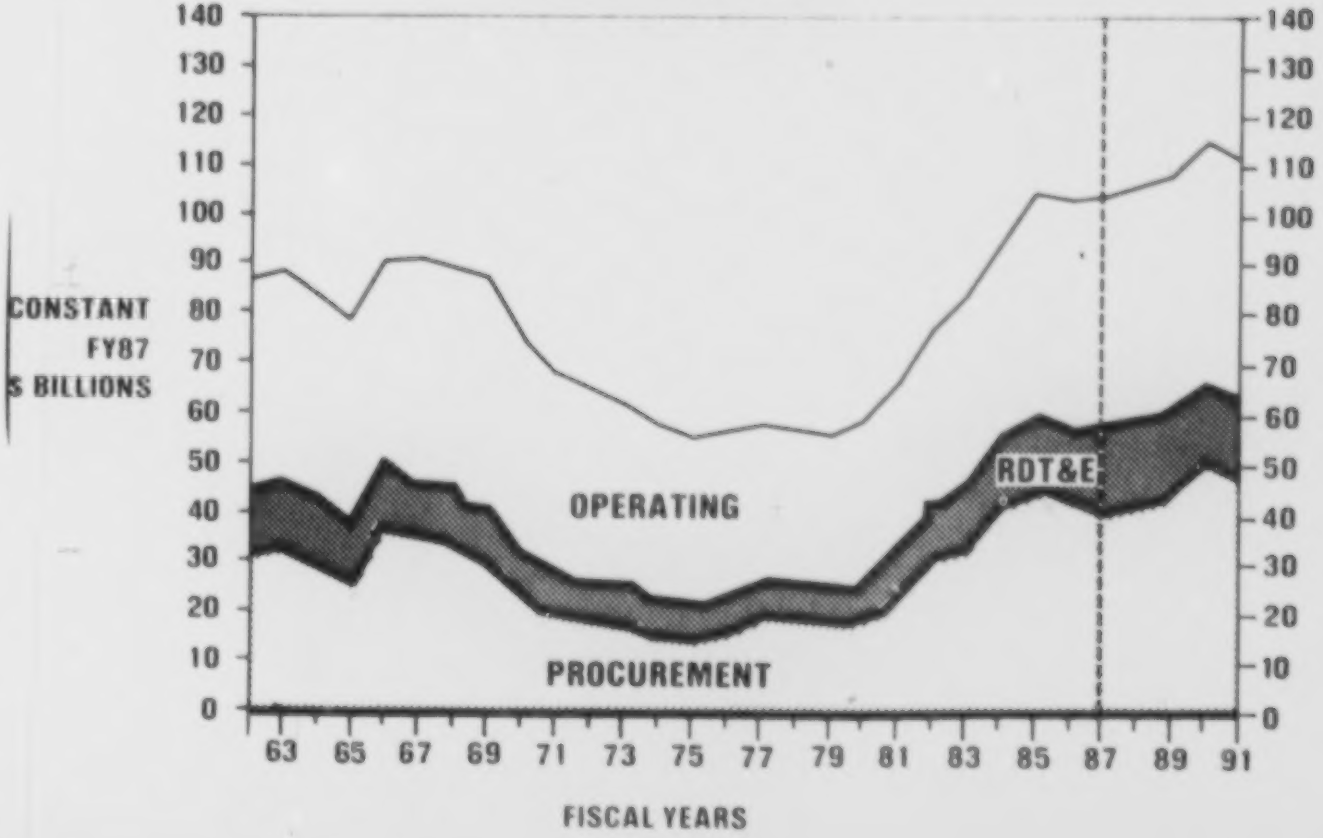


$17.3 billion is the request for this fiscal year, and you see the chart divided up by the different pieces. I would like to point out that there are three parts to the RDT&E budget: The research, about 10 percent of the budget; the test and evaluation, about 20 to 25 percent of the budget; and the remainder is in the development of new programs, and those are the things that we will describe to you in some detail.

Last fiscal year the Congress appropriated $13.7 billion, so that is the increase from 13.7 to 17.3 that you see right there.

Mr. **Darden**. Would you put the chart back you just had before tracking the O&M with the procurement?

## USAF FY87 BUDGET REQUEST
### APPROPRIATION



**General Randolph.** This is the operating budget up here at the top, and this is the investment budget down at the bottom. If you do the calculations, this part is about 55 percent, and this part up here is about 45 percent.

**Mr. Darden.** I had seen some conflicting graphs between the investment and O&M.

**Mr. Battista.** I don't know if this is an anomaly with the Air Force, the investment account skyrockets with a very steep slope; and the O&M account leveling off, and by the time you get to 1991, the gap between O&M and investment is about four to five times larger than the gap is today.

**General Randolph.** This chart is directly from the President's budget as submitted. That is for the Air Force.

**Mr. Battista.** It depends on what assumptions they make, but our data shows just the opposite, and perhaps I can bring that chart by this afternoon. I got it downstairs.

You can perhaps provide for the record an explanation as to why the two are different, but it came right from OSD Comptroller.

[The following information was received for the record:]

### Comparison of O&M and Investment Dollars

The differences between Mr. Battista's chart and the AF chart are:

1. Mr. Battista's chart used data from the Fiscal Year 1986 DoD Budget Request and the AF chart used data from the Fiscal Year 1987 Air Force Budget Request.
2. Mr. Battista's chart used only Operations and Maintenance (O&M) data to compare against the Investment trends while the AF chart grouped O&M, Military Personnel, Family Housing and Stock Fund data into the Operating account to compare against the Investment trends.
3. Mr. Battista's chart used then-year dollars, and the AF used constant year dollars.
4. Mr. Battista's chart started the y-axis at approximately $40 million while the AF chart started at zero.
5. Mr. Battista's chart plotted investment and O&M trends independently while the AF chart showed cumulative trend lines.

The effects of these differences precludes a meaningful comparison of the trends shown on the charts.

**Dr. Cooper.** If you go back to 1981 through 1985, we were increasing in the investment account at a sharper rate than we were increasing in the O&M account.

O&M remains reasonably constant, but we think we have struck a good balance now, and investment continues to go up. O&M stays pretty much the same, so there is a slight trend toward investment, but the point—I don't know that there is a magic relationship between the investment account and the O&M account.

In fact, the investment you make today, much will be supported by the O&M that comes five years from now. C-17, advanced tactical fighters; those all count in the investment portion of our budget today, but they bring with them no O&M.

That O&M tail for those systems will not come until some time later when we are deployed and have used up the initial spares, so there is a time shift between O&M and investment.

**Mr. Battista.** I think it would be wise to get that chart and let you look at that, because our data indicates, and the concern is for every dollar you spend today in R&D, it generates a requirement for 10 or more dollars in the next 5-year period, and we should resolve the differences in the data that we use.

Mine shows a clear break.

General **Randolph**. The point you just made is certainly a very critical and important point, and one of the things at least in the Air Force that we are attempting to do is emphasize reliability.

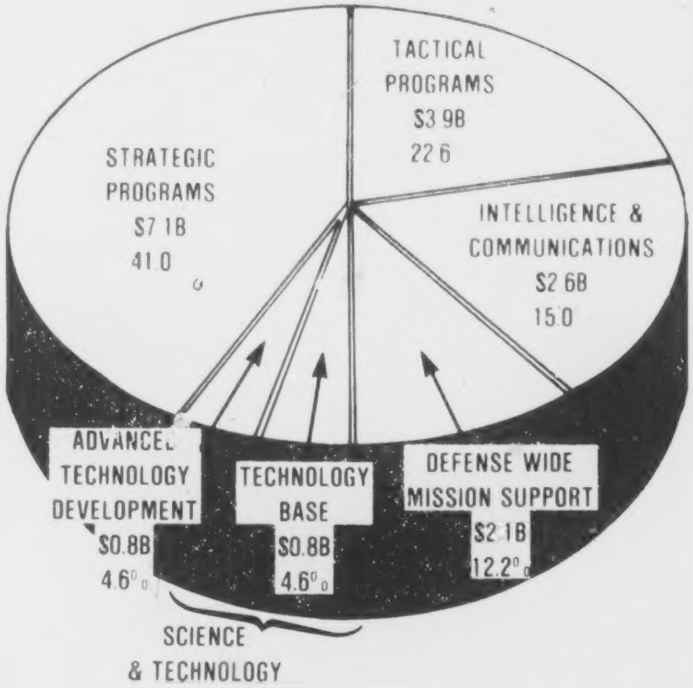
The C-17 reliability is such that it requires about half the number of maintenance manpower hours as a C-5. Design technology has progressed, and if you emphasize doing those kinds of things in the development phase, you reap the benefits in lower operating costs.

Mr. **Darden**. Gentlemen, if we could move on?

General **Randolph**. Yes, sir.

# RDT&E
# USAF FISCAL YEAR 1987 BUDGET REQUEST BY MISSION AREA

**TOTAL: $ 17.3 BILLION**



This is the RDT&E, and last year, the appropriation was $13.7 billion, and this is an increase of about 29 percent from that number.

As I was saying before, and I will repeat myself, about 10 percent of this is in the technology base, and Gen. Bob Rankine will talk about that. That is the research.

About 20 to 25 percent is in the test area, and the remainder is in the development of new systems, so what I would like now to do is to talk a little bit in an overview sense about those new systems, and give you a feel for the scope of the program that we were bringing to your attention.

Dr. COOPER. The way we have outlined the hearing this morning is with the overview on your right. What we propose to do on some of the programs of special interest is to talk about those in more detail later. We have broken those down into the technology base, and General Rankine will speak about that, and a 15-minute presentation on AMRAAM. Then we would move to Theater Forces, and General Loh will speak about that, and from there the Strategic Forces, and end up, if time permits today, with an overview of Space.

General Randolph will touch on most of these programs in his overview, but only briefly. If you would like, we could have the whole hearing on General Randolph's overview.

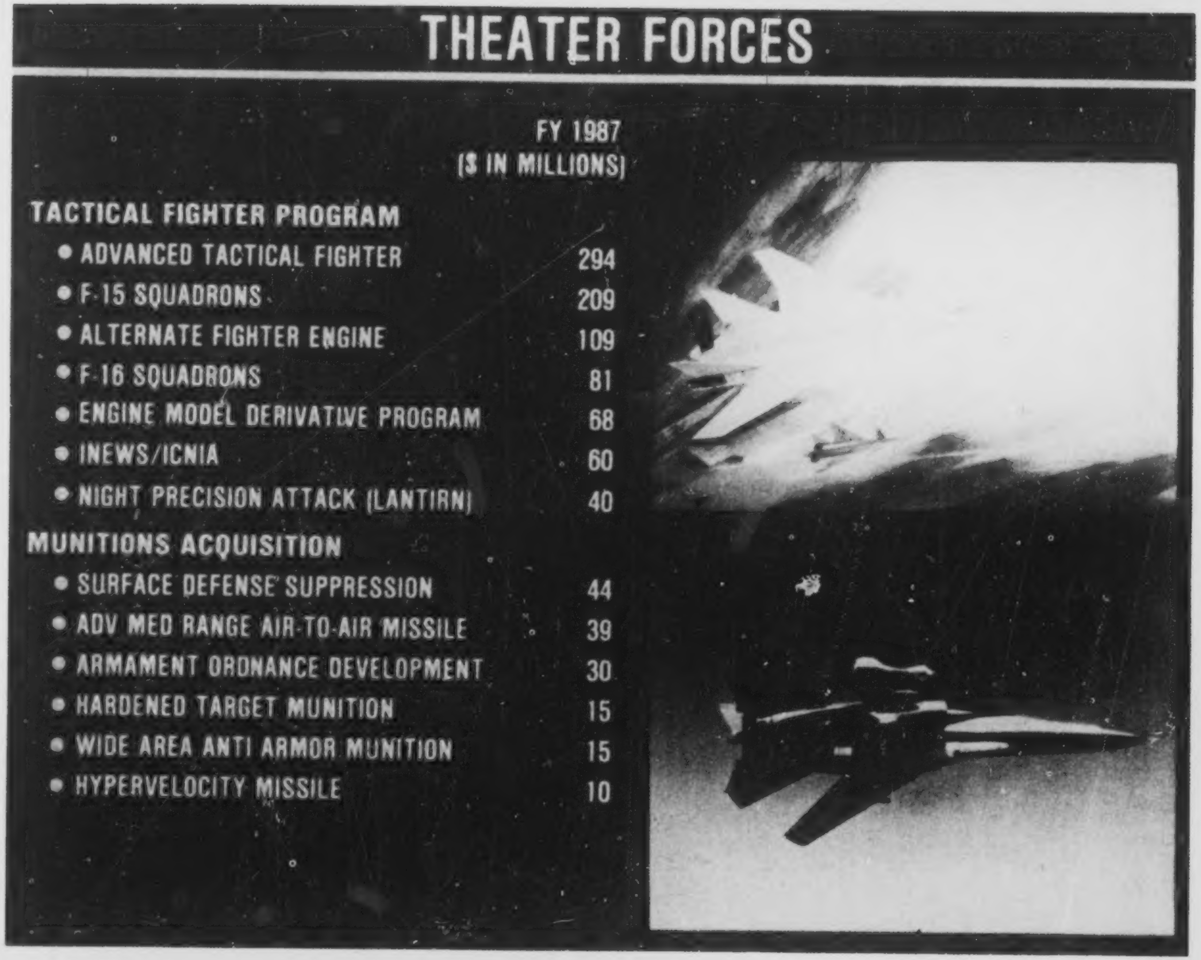
Mr. DARDEN. Let's proceed as you mentioned.

Mr. DICKINSON. In the total scheme of things, when would be the appropriate time to discuss the follow-on Air Force One and Air Force Two.

General RANDOLPH. We can discuss that as soon as it comes up in the chart, and that will come up in a couple of minutes.

Mr. DICKINSON. All right, put on your asbestos pants, and move along.

General RANDOLPH. I am suited.



# THEATER FORCES

| | FY 1987<br>($ IN MILLIONS) |
|---|---|
| **TACTICAL FIGHTER PROGRAM** | |
| • ADVANCED TACTICAL FIGHTER | 294 |
| • F-15 SQUADRONS | 209 |
| • ALTERNATE FIGHTER ENGINE | 109 |
| • F-16 SQUADRONS | 81 |
| • ENGINE MODEL DERIVATIVE PROGRAM | 68 |
| • INEWS/ICNIA | 60 |
| • NIGHT PRECISION ATTACK (LANTIRN) | 40 |
| **MUNITIONS ACQUISITION** | |
| • SURFACE DEFENSE SUPPRESSION | 44 |
| • ADV MED RANGE AIR-TO-AIR MISSILE | 39 |
| • ARMAMENT ORDNANCE DEVELOPMENT | 30 |
| • HARDENED TARGET MUNITION | 15 |
| • WIDE AREA ANTI ARMOR MUNITION | 15 |
| • HYPERVELOCITY MISSILE | 10 |

We have three charts on the Theater Forces. In the case of the Advanced Tactical Fighter, we are moving forward. Primarily most of that money is in the engine development and working the avionics problem, but there is some money there for airframe. This is a follow-on to the F-15, which first flew in 1972.

My perspective is that the grandsons of the wing commanders of the F-15's will be the first guys who fly the ATF's. This is a late nineties airplane. It is a major step forward in the aircraft capabilities, and this airplane can cruise supersonically for sustained periods of time, which is something that you cannot do today.

One program we are proud of is the Alternate Fighter Engine Program, a showpiece of competition between the two engine manufacturers, General Electric and Pratt-Whitney, and we conduct that competition on an annual basis.

As a result, the engines are much more reliable, we have warranties, and we calculate over the life cycle that we will save about $4 billion.

It is a major step.

Dr. **Cooper**. Secretary Rourke last week announced the third installment of the great engine war, 56 percent to General Electric and 44 percent to Pratt-Whitney.

We are extremely pleased with both engines. They both meet all our performance requirements.

To put the $4 billion savings in context, 2 years ago when Vern Orr first announced his decision, the life cycle savings would be between $2 and $3 billion. We upped that to between $3 and $4 billion as a result of the second installment, and this year, it is in excess of $4 billion overall savings.

We continue to gain. The first GE engine will be operational in the F-16's, about the July timeframe of this year.

General **Randolph**. Delivered in May. These two terms here, the integrated electronic warfare systems and the integrated communications, navigation, identification avionics system. And they use very high-speed integrated circuitry technology, and are a major step forward in the avionics business.

### LANTIRN

I had the pleasure of flying the LANTIRN bird. If you told me a year ago I would have sat in the back seat of an F-16, raced through the mountains of California 200 feet above the ground at 500 knots in the middle of the night, I would have said there has to be something wrong with you to think I would do that.

But the LANTIRN allows you to do that, and I was comfortable doing that.

The point is that this denies the night sanctuary, and it is a tremendous step forward in our tactical capability.

Mr. **Badham**. How about the targeting pod?

General **Randolph**. We had a targeting pod on the airplanes. We were able to see small size trucks about 5 miles.

It is about a year behind the navigation pod. The real issue is reliability, which is up, in fact, above where we expected it to be at this point.

Mr. **Badham**. The targeting aspect is coming along?

**General Randolph.** Yes, sir; and we plan to make a decision within the next couple of months.

**Mr. Badham.** That is all great. I admire you driving around at 200 feet radar altitude through the mountains, but if you don't have anything to target——

**General Randolph.** Yes, sir; we had some difficulties with that targeting pod. The contractor is required by contract to meet the reliability levels we need. We are in IOT&E right this minute.

**Mr. Dickinson.** I admire you, too, but I don't envy you.

**Mr. Battista.** If you got this tight contract and the targeting pod is coming along very well, how come you need $40 million this year, because based on your summaries, you should have finished the RDT&E funding the year before last?

**General Randolph.** First, let me say that I took a look at the past budgets, and this is not something new. We had this 1987 money in for several years. Second, the purpose is not so much for the pod, but the automatic terrain following capability that needs to be incorporated, and right today, the automatic——

**Mr. Battista.** That is a different account. That doesn't relate here. That is in the 63 line. I am referring to the fact that you had a fixed price contract and it was capped, and that number was $523 million, and you are now over $600 million if you get this from the Congress this year.

So what I am suggesting is, with that tightly controlled fixed price contract, was capped a year and a half ago, and we are still spending all this money.

**General Randolph.** The cap is for the production contract.

**Mr. Battista.** Your predecessor told us it was R&D.

**General Randolph.** We capped the total program at $2.31 billion for 700 pod sets in fiscal year 1980 dollars. The pods are warranted for 2 years, or 400 hours, whichever comes first.

That is in the contract. The development effort that we have in fiscal year 1987 is the automatic terrain avoidance. We had to fly the airplane by hand.

What you need for the pod is an interface that makes the automatic terrain avoidance work and incorporate it into that pod. That is what the fiscal year 1987 money is for.

**Mr. Battista.** These are modifications to the Navigation (NAV) pod?

**General Randolph.** Right, to make sure that it interfaces with the airplane, most of the automatic terrain avoidance work is in the airplane, but we have to make sure that an integration is included in the pod.

Plus the testing; there is a significant amount of additional testing also included in that 1987 budget line item.

**Dr. Cooper.** This is his first year. I saw the words in the report, Tony, where allegedly someone said last year would be the last year for R&D.

We have had our guys research that, and I can't find that anyplace where we said it, and I would be interested in looking at descriptive summaries.

**Mr. Battista.** That is where it is.

Look at 1983, 1984, and 1985 and you follow, remember, it was $93 million, $180 million, $225 million, and kept going up, it was Larry who had indicated that they had the cap on the contract.

Dr. COOPER. Larry Skantze?

Mr. BATTISTA. Yes.

Dr. COOPER. The R&D bill has gone down from what we told you last year. We told you it was going to be $570-some million for R&D. This year we are showing $535 million, and the R&D is essentially complete.

We have $20 million in 1988 and nickels and dimes from 1989 on, so the R&D is essentially complete on it, and the program cap is at $2.31 billion (base year 1980 dollars) for the 700 pod sets.

We have not said everything is OK with the targeting pods. We told you we were having problems with the targeting pod, and notwithstanding the fact that our budget request had funds to go into production, we recommended that we delete those funds and slip the targeting pod by a year, and that is what the restructured program now shows.

We went into production with the navigation pod at this time last year, in April. We believe we are going to be ready for production with the targeting pod in about the same timeframe of this year, 1 year removed.

We have not had a formal production review of it, and that is due to come up to General Randolph and myself in 2 months. From what we see, indicators are good and going back to when we made the decision on the navigation pod last year, the targeting pod is about in the same situation, so I anticipate a favorable production decision.

The jury was still out on the targeting pod last year for some of the reasons mentioned, but it is coming along now and we will have both good navigation and targeting pods.

Mr. BATTISTA. Could you check the descriptive summary and resolve that difference. When we put the report language together, we had all 3 years in front of us.

[The following information was received for the record:]

### NAVIGATION AND TARGETING PODS

The Air Force has reviewed the Descriptive Summaries for fiscal years 1983, 1984 and 1985 and cannot find any reference to the $93 million, $180 million and $225 million RDT&E costs, nor to any statement by the Air Force that FY 1986 would be the final year for LANTIRN research and development authorization as noted in the FY 1986 HASC report.

Total estimated RDT&E costs (in then year dollars) for the LANTIRN program, as shown in the FY 1983 through 1985 Descriptive Summaries, are as follows:

FY 1983 Descriptive Summary: $468.8 million.

FY 1984 Descriptive Summary: $516.3 million.

FY 1985 Descriptive Summary: $549.9 million.

Additionally, the FY 1985 Descriptive Summary (as submitted in 1984) showed an "Additional to Completion" amount of $80.7 million for RDT&E beyond FY 1986. Therefore, the RDT&E funding requested remains a valid requirement to continue the LANTIRN program.

Dr. COOPER. If that was said, that was wrong. All the documentation I can find going back 4 years shows we have R&D funds in the budget out through 1990-91.

Mr. DICKINSON. How much is in here for the TFR?

General **Randolph**. About half of the money. The remainder is for integration work, flight testing work, and new depot software development.

Mr. **Dickinson**. Speaking as a nontechnical person, I don't understand why it would cost that much and be that much of a problem.

We have a TFR in the F-111 now, and built into the C-5, so it is not a new technology, and I don't understand why the dollar figure would be so high, if it is an in-hand capability, and the state of the art has been in existence for 20 years.

Why the big bucks?

General **Randolph**. The work will establish the interfaces with the airplane software; that is the fly-by-wire system in the F-15E, and making sure that it talks to the pod, and that is the part that takes the effort.

It is not a lot of effort, but it costs some money to do, and make sure it is done right. It is not a technological thing, and we are not repeating something we have already done.

This is a new interface, and this is a new situation whereby the software in that pod talks to the software in the F-15E and F-16.

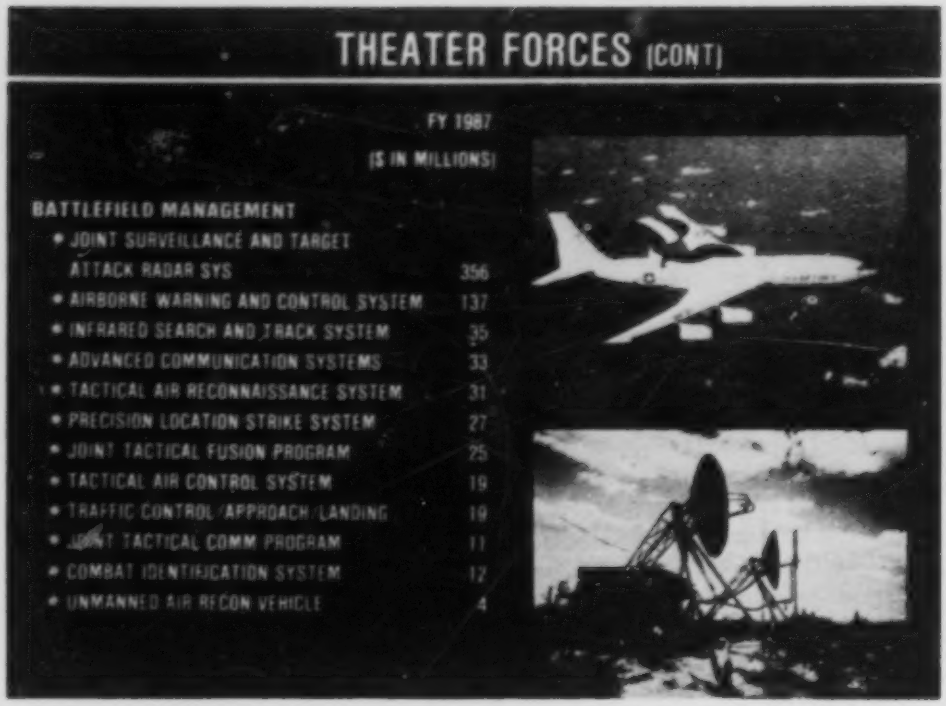
We will get you some more specific details on that.

General Monahan is going to talk about the munitions program, because that is a matter of some interest to us, and as Dr. Cooper mentioned, General Ferguson is here, and he will speak about the advanced medium-range air-to-air missiles.

We are making excellent progress in the area of smart munitions, and we are working hard on that.

The people that work on these programs, and I know they take a lot of guff, are professionals. They are Air Force, uniformed people and civilians; they are well-trained, they have experience, and they work these problems hard. The results show that they are doing a good job.

We have been criticized quite a bit. In the main, they work out quite well. This is the second chart here, the joint surveillance and target attack radar systems, joint STARS, and let me put joint STARS in perspective.



## THEATER FORCES (CONT)

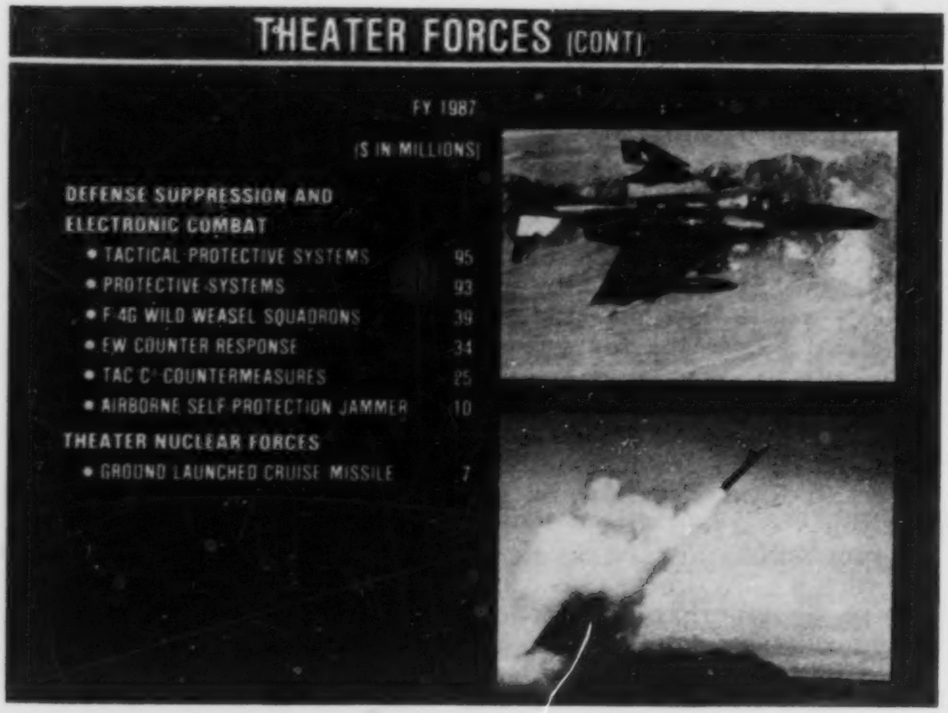
| | FY 1987<br>($ IN MILLIONS) |
|---|---|
| **BATTLEFIELD MANAGEMENT** | |
| • JOINT SURVEILLANCE AND TARGET ATTACK RADAR SYS | 356 |
| • AIRBORNE WARNING AND CONTROL SYSTEM | 137 |
| • INFRARED SEARCH AND TRACK SYSTEM | 35 |
| • ADVANCED COMMUNICATION SYSTEMS | 33 |
| • TACTICAL AIR RECONNAISSANCE SYSTEM | 31 |
| • PRECISION LOCATION STRIKE SYSTEM | 27 |
| • JOINT TACTICAL FUSION PROGRAM | 25 |
| • TACTICAL AIR CONTROL SYSTEM | 19 |
| • TRAFFIC CONTROL/APPROACH/LANDING | 19 |
| • JOINT TACTICAL COMM PROGRAM | 11 |
| • COMBAT IDENTIFICATION SYSTEM | 12 |
| • UNMANNED AIR RECON VEHICLE | 4 |

The AWACS looks out at the air battle. The joint STARS is designed to look at the ground battle, detect and attack enemy tanks, provide the information to the Army so the Army can attack.

General Rogers from Europe is very high on the need for this, and has pushed us very hard to move this program forward rapidly.

Dr. COOPER. General Russ used to like to call it the upside down AWACS. The AWACS looks to the air-to-air battle and the joint STARS will look at what is going on on the ground.

General RANDOLPH. When I started to look at these programs, I found that over half of these are joint programs, and you will see more and more as we go through the programs. Many of the programs that the Air Force is accomplishing are joint programs, and we are often criticized for not doing joint programs. We do quite a few.



THEATER FORCES (CONT)

| | FY 1987<br>($ IN MILLIONS) |
|---|---|
| **DEFENSE SUPPRESSION AND ELECTRONIC COMBAT** | |
| • TACTICAL PROTECTIVE SYSTEMS | 95 |
| • PROTECTIVE SYSTEMS | 93 |
| • F-4G WILD WEASEL SQUADRONS | 39 |
| • EW COUNTER RESPONSE | 34 |
| • TAC $C^3$ COUNTERMEASURES | 25 |
| • AIRBORNE SELF PROTECTION JAMMER | 10 |
| **THEATER NUCLEAR FORCES** | |
| • GROUND LAUNCHED CRUISE MISSILE | 7 |

This is an area I am not too pleased with, electronic combat. It is a tough area, because it is a cat-and-mouse game. We always are trying to catch up with what the other guy is doing, but we still need to tighten our organization. Within the Air Force, we are doing that, between our systems and logistics command and staff, and we are working the problem closely with the Navy, but that is an area that needs to be beefed up.

Dr. COOPER. I know Mr. Battista has brought this up as a point many times during the hearings, and we may disagree with some specifics, but not with the major points that you have brought up.

Much of what we have done in the electronic combat world has been in the nature of a quick reaction capability (QRC). We field the system, go out, get in a conflict, lose some airplanes, develop a black box to address that specific situation.

We are trying to get our hands around that, and I won't say we have not done a good job, but it has been a difficult job.

The only system that I can think about recently where we have done it in an orderly way, where we have anticipated, is the ASPJ, airborne self-protection jammer. We sat down and thought about that.

There is a lot of room for improvement in that area.

Mr. BATTISTA. I looked at the plan brought over this week that will carry us out through the year 2000 for electronic warfare, and it is not a plan but a commitment to inferiority for the next 15 years.

I can't imagine we are going to go with a 131 pod in the year 2000, and you look at the logistics profile, 135 and F-15, 131, and the 126, and the F-14, a logistics tail that won't quit, and the EW roadmap that came out of C3, it is a commitment to inferiority.

We are going to spend $6 billion in the next 5 years, and we are not going to get anything for it.

General, you said the Navy is on board with INEWS/ICNIA, F-15 will not have it?

General RANDOLPH. I said we are working with the Navy.

Mr. BATTISTA. You are struggling with the Navy.

General RANDOLPH. We are working with the Navy.

Mr. BATTISTA. What can we do between now and markup? You admit, you are unhappy with that program. What can we do that makes sense between now and March 13?

General RANDOLPH. My answer is that we have to support the President's program. That is the President's program.

Mr. BATTISTA. Do you really think the President is aware of the 131 pod, SEEK RAM? The fact of the matter is, it is not responsive. We admit it, and you do, too.

General RANDOLPH. I think we need the money. The question that you are trying to get your arms around is how to focus the program, and we are trying to do that.

In fact, we are working that problem right now. I am not pleased with the reports that you got, and that is what I have just finished telling you, but I don't have an answer right now.

SEEK RAM, I am not at all sure that is the right way to go. We have a review due in March to take a look at it and, detgermine if we should do the upgrades to the 131, but I am not thrilled about it now.

We put the scientific, Air Force Scientific Advisory Board to work on exactly the problem you mentioned, and they are to give us a report on that.

Mr. BATTISTA. The requirement is real, you need the money, but the program is terrible. We have to mark up on the 13th. All I can suggest is, we are here, and if you want to restructure the program in a direction that makes sense, you can call any time of day or night.

We are ready, but I would hate to see the money go away because of the inadequacy of the program, but that is the way it is right now.

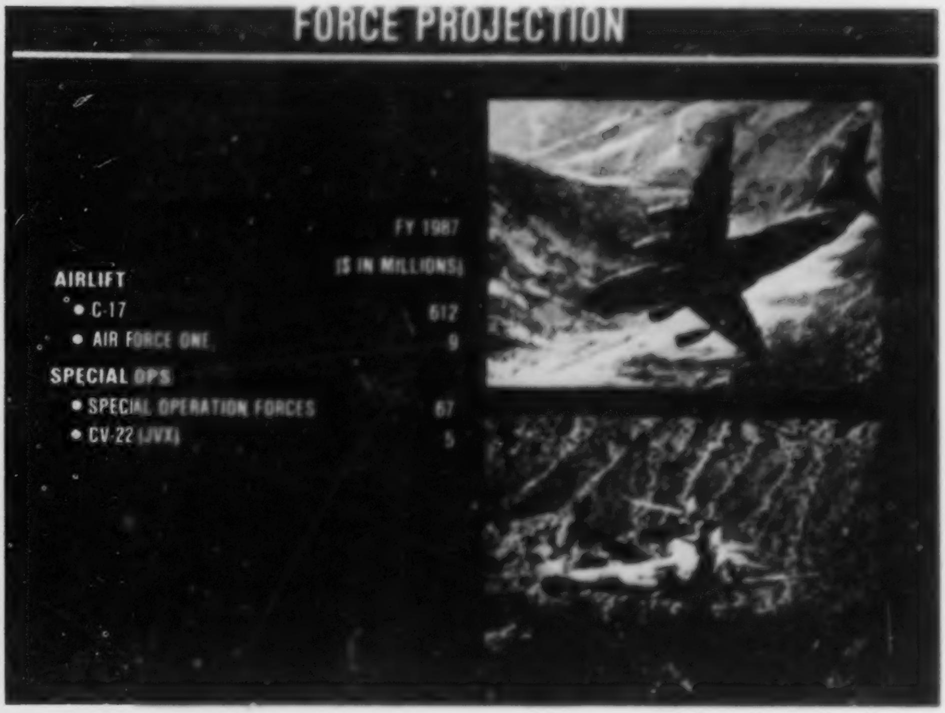
Dr. COOPER. I don't think there is anything of substance we are going to do between now and March 13. We can talk about plans. We have to dance with the ones we brought.

Mr. DARDEN. This is your story, and you are sticking to it.

Dr. COOPER. We are acknowledging that there is work that needs to be done in the electronic warfare area, but we are not going to switch out all the jammers on F-15's and 16's, overnight. We have a commitment in our new aircraft; we are talking about INEWS, Intergrated Electronic Warfare System.

That is something we think both the Air Force and the Navy should work on jointly, and many of these programs should be worked on jointly, but we have a fleet of aircraft out there that need electronic protection, and they have to stick with what they have got in the near term.

This is not something we are going to solve overnight. We acknowledge this is a problem within, and will continue to work with you on it.



FORCE PROJECTION

| | FY 1987 ($ IN MILLIONS) |
|---|---|
| AIRLIFT | |
| • C-17 | 612 |
| • AIR FORCE ONE | 9 |
| SPECIAL OPS | |
| • SPECIAL OPERATION FORCES | 67 |
| • CV-22 (JVX) | 5 |

General RANDOLPH. Force projection, and I move to this chart with a bit of trepidation because Air Force One is on the chart.

The C-17 you see there. When I was in Vietnam, I worked the airlift problem, up in the northern part of South Vietnam, and I am here to tell you that the throughput issue, as far as airlift is concerned, is very important, and the C-17 addresses that.

The C-17 has three times the throughput of a C-5 and costs considerably less to operate. It costs about $6,000 an hour to fly a C-5; and $3,000 an hour for a C-17. There is a considerable savings in terms of the airplane.

Mr. DARDEN. General, this is an ongoing controversy, and we could debate this issue for the next 3 or 4 weeks, but I don't want to get into that this morning.

I would like to have the Air Force's response to the Heritage Foundation report.

[The following Information was received for the record:]

### HERITAGE FOUNDATION REPORT

The Air Force's response to the Heritage Foundation Report is attached.

## RESPONSE TO HERITAGE FOUNDATION BACKGROUNDER ASSERTIONS

HERITAGE FOUNDATION ASSERTION: That a new generation strategic airlifter is not necessary. (page 6, item 1)

RESPONSE: A new generation airlifter is needed to meet our complex airlift requirements, and we are going to demand more than just strategic lift capability from it. The C-5 is a great aircraft with tremendous lift capability; however, in part because of its very large size, it cannot do everything that we need. We need the C-17 not only to provide increased strategic airlift, but to operate into forward areas, provide direct delivery and airdrop capability, and not close airfields just because one or two aircraft are on the ground. The C-17 provides much better ground handling characteristics and can operate into many more airfields than the C-5, with substantially improved R&M and reduced O&S costs. The C-17 will provide the much needed capability and require 14,800 fewer manpower slots compared to any other viable solution to our airlift problems. These manpower slots are badly needed to meet other Air Force and DOD requirements.

HERITAGE FOUNDATION ASSERTION: That it is (A) questionable whether the C-17 will be available for tactical combat support roles in a major war and (B) some experts see problems with a hybrid design that equips the C-17 for both strategic and tactical missions. (page 6 item 2)

RESPONSE: (A) We plan on using the C-17 to fly tactical airlift sorties while rotating between strategic airlift missions. In addition, because the C-17 can carry four times the load (average payload) of a C-130 and will fly directly to some final offload locations, this will eliminate the need for a number of tactical sorties. When a greater tactical requirement exists, the C-17 can augment the C-130s and perform those needed missions before resuming strategic missions. In a Jan 84 memo to the Army Chief of Staff, Gen Gabriel, AF/CC, stated that "In an intratheater role, the C-17 can deliver people, equipment and supplies to the brigade level and even further forward, if required. Its design will allow delivery of all sizes of cargo ... maneuverability ... redundant systems ... more survivable than any current airlifter. Additionally, its larger payload and smaller crew size allow effective risk management by exposing fewer people and aircraft to forward area threats." Gen Vessey, in a Jan 84 memo to SECDEF supported this position; the C-17 would be used in a tactical environment.

(B) Regarding the "hybrid" design, the C-17 is designed to do both inter- and intratheater airlift operations. The technology which will be used in the C-17 incorporates proven concepts from the YC-14/YC-15 prototypes. The end result is an aircraft which blends range and performance with capacity and maneuverability. Its size, performance, and high R&M will enable efficient operations at onload, enroute, and offload bases and impose few demands on the airlift system. The C-17 will significantly increase the efficiency, flexibility, and capability of the airlift fleet and minimize cost of ownership. With the C-17, we expect significant improvements in throughput of personnel and cargo and reduced force closure time.

HERITAGE FOUNDATION ASSERTION: That it is unrealistic to expect the Air Force to risk the C-17 on "austere" airfields in or near combat zones. (page 6 item 3)

RESPONSE: See part (A) of previous answer.

HERITAGE FOUNDATION ASSERTION: That (A) buying more C-5Bs instead of C-17s and not retiring C-141s and C-130s will save money. That (B) a new tactical airlifter is needed to replace the C-130. (page 7 item 4)

RESPONSE: (A) Some C-130s and C-141s will be nearing the end of their service lives by the mid 1990s. The older C-130s and C-141s should be retired, and we need to transfer some C-141s into the Reserves in order to reduce their utilization rates and, therefore, extend their lives well into the 21st century. We do not consider it feasible to continue operating these planes indefinitely at current utilization rates. Strictly buying C-5s instead of C-17s would save acquisition funds, but this does not address the replacement cost of additional C-130s, service life extension costs for the C-141, early retirement of the C-141 if they are operated at present utilization rates or the comparatively high O&S costs associated with the C-5, C-130 and C-141. As previously mentioned, the C-17's improved R&M and updated systems will result in significant savings in cost of ownership (fuel, spares, manpower) than other viable solutions to the airlift problems.

(B) The C-17 is not a replacement for the C-130, but the C-17's tactical capability will allow the needed retirement of the older C-130s in the mid 1990s and at the same time greatly increase our tactical airlift capability. At some future time, a new tactical transport may be needed; some preliminary work has been started to develop the concept and requirements for tactical airlift after the turn of the century.

HERITAGE FOUNDATION ASSERTION: That the design and operational concepts for the C-17 and C-5 are remarkably similar. (page 8 item 1)

RESPONSE: While both aircraft are designed to perform the intertheater airlift mission and are capable of carrying outsize cargo, there are substantial differences in capability, flexibility and intended utilization. The C-5 is a long-range intertheater airlifter only. It does not have a tactical mission, is physically too big to operate into fields with limited ramp space, requires too much support, and lacks the performance to operate into many of the smaller fields that we intend for the C-17. Turnaround times and airfield congestion further limit the utility of the C-5. In a typical scenario with limited ramp space, the C-17 throughput is three times that of the C-5 over the same amount of time. The C-17 will provide direct delivery, allow more aircraft on the ground, can be on and off loaded more rapidly, requires fewer people to operate, and can perform outsize airdrop and low altitude parachute extraction (LAPES) missions which the C-5 cannot.

HERITAGE FOUNDATION ASSERTION: That Lockheed claims the recent test of the C-5 demonstrates its ability to operate into runways only 3,000 feet in length and that even if it needs 4,000 to land, it barely will be at a disadvantage compared to the C-17. Reason: only a tiny fraction of airfields in Europe, Northeast Asia, and Southwest Asia are between 3,000 and 4,000 feet long and thus can accommodate the C-17 but not the C-5. (page 9 item 2)

RESPONSE: As far as we know, the 1984-85 Lockheed tests to demonstrate additional C-5 capabilities examined backing and heavy weight operations only and not landing on 3,000 foot runways. Test results have not been released at this time. We are not aware of any recent tests by Lockheed to demonstrate operating on 3,000 to 4,000 foot runways. However, early tests with the C-5A did demonstrate that it could land and takeoff within a 3,000 foot distance. The tests were conducted by highly qualified test pilots and under certain load, runway and weather restrictions. Due to operational and safety considerations, MAC has restricted the C-5 to runways of 5,000 feet. Even if the C-5 were flown into a 3,000-4,000 foot airfield, the airfield environment (trees, buildings, etc.) and taxiways and ramp space would have to be such as to accommodate the aircraft size and turning radius. Regarding the number of airfields available to the C-17 versus the C-5, extensive runway analysis done when developing C-X requirements showed available Free World airfields (minus the US) increased 75% (to 9,887 from 5,640) for runways greater than 3,000 feet but less than 4,000 feet long when compared to runways greater than 4,000 feet. In absolute terms, 4200 more airfields dramatically increase mobility options and gives theater commanders the flexibility to position and maneuver combat forces to maximum advantage.

HERITAGE FOUNDATION ASSERTION: That because the C-5B delivers more cargo than the C-17, fewer C-5Bs will be needed to deliver the same load, thus decreasing congestion. Backups are cut even further by the C-5s because their front and rear loading doors allow them to move in and out of the airports quickly. Preparing European airfields for better use by the C-5 by eliminating trees, fences, and other obstacles at some narrow airfields or pouring more concrete or laying metal planks for better use by the C-5B is no major undertaking. (page 9 item 3)

RESPONSE: Delivering a certain payload is not only a function of maximum aircraft capacity but is also dependent on ground time and the number of aircraft that can be on the ground at one time. The C-17's smaller size, coupled with its maneuverability, means more aircraft on the ground at any one time and faster offload means more aircraft can cycle through during a given time. The C-5 is less maneuverable and must kneel to offload rolling stock, thus requiring more ground time. In the event that a major operating base is interdicted, the C-17 will permit much greater flexibility to disperse the airlift flow. Modifying the runway/airfield environment may be possible if the host government or enemy allows it. Most effective airlift operations use what is available and make changes to the airfields when no other options are available. It makes little sense to degrade the C-5's excellent strategic capability to perform a mission for which it is only marginally capable.

HERITAGE FOUNDATION ASSERTION: That the Air Force should retain the Congressionally Mandated Mobility Study goal of 66 million ton miles per day of airlift requirements. (page 10 item 1)

RESPONSE: We agree.

HERITAGE FOUNDATION ASSERTION: That the C-17 program should be cancelled, build more C-5Bs and KC-10s and retire no C-130s. (page 10 item 2)

RESPONSE: The C-17 program must continue for many very sound and logical reasons. From an economic standpoint, it saves $16B in life cycle costs and avoids 14,800 manpower positions compared to a mix of C-5B/C-130s that would otherwise be required. From an operational standpoint, the C-17 technologically modernizes the airlift fleet, provides substantially improved flexibility, satisfies the existing shortfall in intertheater capability and reduces the intratheater airlift shortfall, greatly improves our ability to position troops and equipment right where they are needed, gives us an outsize airdrop and LAPES capability, and reduces the problems of congestion that will occur at both major and forward operating bases. A minimum of 100 C-130s must be retired in the near future as they can no longer be economically maintained and operated. Other C-130s will not be far behind this first group. While the KC-10 is a great refueling platform and can provide intertheater airlift capability, it cannot transport outsize equipment, requires special loading equipment, is not capable of any tactical operations and cannot operate into small or forward operating bases.

HERITAGE FOUNDATION ASSERTION: That the Air Force not retire or transfer any C-141s. (page 10 item 3)

RESPONSE: Current plans are to transfer 80 of the 234 PAA C-141s to the Air Reserve Forces (ARF), not the 180 originally envisioned in the Airlift Master Plan or mentioned in the Heritage paper. These transfers are based on many factors; readiness, force sustainment, cost-effectiveness and operational flexibility. We estimate that 54 C-141s will need to be retired by 1998 due to high flying time and extensive exposure to the turbulence and g-loading of low level flight. Transferring the 80 aging aircraft to the ARF will reduce the utilization rate of these aircraft and insure that they remain available for contingency or wartime use if needed. In addition, the FY 84 Defense Appropriations Bill directed the transfer of two C-141 squadrons to the ARF and required the Air Force to submit a plan for transferring additional strategic airlift aircraft to the ARF.

HERITAGE FOUNDATION ASSERTION: That the Air Force consider developing a new short range "tactical" airlifter to replace the C-130. (page 10 item 5)

RESPONSE: As previously stated, the Air Force recognizes that at some future time a new tactical airlift aircraft may be required. The Airlift Master Plan and the C-17 compensate for the retirements of C-130s throughout the 1990s. Preliminary studies to develop the concept and requirements for future tactical airlift needs after the year 2000 have been initiated.

HERITAGE FOUNDATION ASSERTION: By some calculations, adding 101 C-5Bs to the fleet to meet the Pentagon's goal of 66 MTM/D airlift capability would cost at most $16.8 billion. And this is at an inflated "then year" dollar cost ... is still far below the then year $37.2 billion acquisition cost for the C-17. (page 7 item 4)

RESPONSE: Air Force data comparing C-5Bs and C-17s has also indicated lower acquisition cost for a C-5 option. However, acquisition costs are only the tip of the iceberg when determining the true cost of more C-5Bs rather than developing the C-17. The operational and support costs (fuel, personnel, spare parts, etc.) over some specified period of time must be considered. However, the primary reason for selecting the C-17 was its increased ability to meet mission requirements and objectives. At the same time we also obtain an aircraft with significant improvements in reliability and maintainability over the C-5B.

The Heritage Report estimate of $16.8 billion for 101 C-5Bs is compared to a 210 C-17 program cost of $37.2 billion. The FY 87 budget for 210 C-17s is actually $35.9 billion ($27.0B in FY 86 dollars) for R&D and Procurement, some $1.3 billion lower than last year's estimate used in the report. However, the 101 C-5Bs should be compared to 115 C-17s and not 210. Only 115 C-17s would be needed to provide the same intertheater lift capability of the 101 C-5Bs. The cost of 115 C-17s would be significantly less than the $37.2 billion 210 aircraft program but still somewhat higher than the Heritage figure of $16.8 billion for 101 C-5Bs. The Airlift Master Plan examined the 101 C-5B and the 115 C-17 options and computed acquisition costs in FY 82 dollars at $11 billion and $16.5 billion respectively. However, both options were rejected since neither addressed the criteria of minimizing operations and support costs, manpower requirements and needed force modernization to replace aging C130s and C-141s.

The planned 210 C-17 aircraft program addresses all of our airlift needs, and as noted earlier, does it at the least overall costs in both money and manpower. The C-17 will form the basis for an effective airlift fleet well into the 21st century.

General RANDOLPH. Yes, sir, and General Loh will talk in more detail, and he will discuss a little bit more about the Heritage Foundation. We will also work that with you.

Mr. BADHAM. Did you bring General Cassidy with you this morning?

General RANDOLPH. I talked to General Cassidy yesterday at some length. General Mike Loh has all of the information that General Cassidy has available.

Mr. BATTISTA. We met with him Friday, and I will say that the best story I have heard in the last 7 years on strategic mobility he had. He had a better story to tell in 10 minutes than we have heard in seven years, really a cohesive, cogent story.

Dr. COOPER. He will be back in town, I believe, next week, and we would like to pay some visits, if we could. We discussed with him about coming over today, but with what we had on the docket, it would turn into a C-17, C-5 hearing, so we chose not to do that.

Mr. DARDEN. We could take the next three weeks—we are primarily here for an overview today, and hear Mr. Dickinson get into Air Force One.

General RANDOLPH. Air Force One: we have proposals in hand now from the contractors who are bidding, and we are evaluating those proposals. I have taken a look at the dollars that they propose with the money that were appropriated, but not yet authorized last year, and with the moneys that we are asking for in fiscal year 1987, and a small amount in 1988, we believe that we have adequate dollars to take care of the Air Force One acquisition.

Now, I recognize, sir, that the problem was that we were out of cycle with our requests, but the President's airplanes right now are 13 years old for his primary, and 23 years old for the back-up airplane versions of the 707.

Many of the major airlines are phasing those out, and it is getting more difficult to get the spare parts because they are basically commercial machines, and there are noise problems with the engines. These are a number of reasons why we need to replace those airplanes.

Where I think we made the mistake was that one of the major competitors, McDonnell Douglas, was about to shut down their line for the KC-10, so that is why we came up with the out-of-cycle request.

I know that was not the best course of action, but we believe that the program we have laid out right now to provide the President with efficient transportation is a reasonable one.

Sir.

Mr. DARDEN. Mr. Dickinson.

Mr. DICKINSON. I don't think anyone on this committee and no one in the Congress would deny the fact that at some point in the near future, we have got to come up with a follow-on aircraft, to give transport to the executive branch, but I don't know who dreamed up all this business that you first came up with, and that immediately raises a flag.

Now, you had $99 million in there just for R&D.

General RANDOLPH. Yes, sir.

Mr. DICKINSON. What do you get for $99 million. An EMP hardened 747. Do we go with the DC-10, the 747, it has already been hardened. I understand that you have been able to scrub about $50 million out of the original request?

General RANDOLPH. Yes, sir.

Mr. DICKINSON. We can take credit for that saving, anyway. What are you looking at—you are talking two planes, Air Force One and Two, aren't you?

General RANDOLPH. No, sir, the primary and the backup.

Dr. COOPER. Two aircraft, right.

Mr. DICKINSON. You are looking at—did you get a bid on the unit cost for the DC-10 vis-a-vis the 747?

General RANDOLPH. Yes, sir, we are in the source selection. The $280 million that the Congress appropriated is adequate in our view to handle the acquisition of the two airplanes.

Now, I really can't go into it too much more, because we are in the process of negotiating with the two guys.

Mr. DICKINSON. Is that just a barebones bird?

General RANDOLPH. No, sir, that is the acquisition of the bird without the necessary work to do the EMP hardening. There is a communications suite design, EMP hardening, and flight testing; about $41 million in R&D. That is in addition to that $280 million, and money for initial spares, which is also in addition to that $280 million.

When you add it up, the bottom line is about $400 million for the two airplanes.

Mr. DICKINSON. Plus what?

General RANDOLPH. Operations and support, but that is the total number.

Mr. DICKINSON. What about MilCon? You forgot to mention that little hummer over there?

General RANDOLPH. No, sir.

Mr. DICKINSON. Total program costs, what are we looking at, to buy two airplanes, so the President can fly around and talk to people, what are we talking about in program costs?

Dr. COOPER. $450 million, round numbers. Roughly $400 million acquisition, procurement, the initial spares that we always buy when we buy the first article and, the R&D. In round numbers, $400 million, and you are talking another $50 million plus or minus in MilCon; $450 million is where we are right now. We think that is the top range.

Mr. DARDEN. Including all the communications equipment, football?

Dr. COOPER. Absolutely. That is a large cost of the aircraft.

Mr. DICKINSON. All the black boxes and communication equipment is in this figure?

General RANDOLPH. No, sir, if you recall, the Congress gave us seven communications suites. We were going to replace the suite in the current Air Force One. We now propose to put that suite into the new Air Force One, if Congress approves.

Dr. COOPER. That money is available.

Mr. DICKINSON. In connection with this, I believe we have a small entourage that is going to trail on behind the plane, like what, eight CH-53's?

Dr. COOPER. I don't know anything about that. It is a large entourage that accompanies the President.

Mr. **McCurdy**. Is this plane big enough that he can put his limo up on the back end?

General **Randolph**. No, sir.

Mr. **Dickinson**. They got to send that on a 141. My problem is, I just cannot understand why it would cost this sort of money to buy two aircraft with the electronic communication equipment that is needed.

What I would request you to do is give us the barebones figures that are absolutely required, and so that then this committee can look at them and sign off on them, and say this is reasonable, this is not reasonable.

[The following information was received for the record:]

### Air Force One

The Air Force has received technical and cost proposals on the Air Force One Replacement Program from both Boeing and McDonnell Douglas; however, these data are not releasable outside the competition process until source selection is completed in May 1986. Any disclosure of contractor cost data at this time would compromise source selection and jeopardize competition. Nevertheless, we have attached our most recent estimates for your information. We would expect these estimates to be revised when the actual contractor figures are released.

The information shown below is based on our latest estimates of the amount needed to execute the program.

AIR FORCE ONE REPLACEMENT PROGRAM—GENERAL BASELINE REQUIREMENTS AND COSTS

[In millions of dollars]

| | Fiscal year 1986 | Fiscal year 1987 | Fiscal year 1988 | Fiscal year 1989 | Total |
|---|---|---|---|---|---|
| RDT&E costs: | | | | | |
| Comm/Nav design (see requirements at TAB) | 9.4 | 2.0 | | | 11.4 |
| EMP hardening design (see requirements at TAB) | 9.5 | 6.7 | | | 16.2 |
| EMP testing—Systems level testing of the EMP hardening | | | 5.4 | | 5.4 |
| Flight/systems testing—Wide body FAA certified and testing of antennas/interference/interoperability | | | 7.0 | | 7.0 |
| Mission support | 0.6 | 0.3 | 0.3 | 0.2 | 1.4 |
| Total RDT&E | 19.5 | 9.0 | 12.7 | .2 | 41.4 |
| Unit flyaway and nonrecurring costs | 280.0 | | | | 280.0 |
| Unit air vehicle—Two wide body commercial aircraft [1] | | | | | |
| Unit interior—Unique design interior [1] | | | | | |
| Unit Mission Communications System (MCS)—Integration/installation of GFE MCS (see requirements at tab) [1] | | | | | |
| Unit EMP hardening (see requirements at tab) [1] | | | | | |
| Unit avionics [1] | | | | | |
| Unit ECO [1] | | | | | |
| Nonrecurring [1] | | | | | |
| Total flyaway and nonrecurring | 280.0 | | | | 280.0 |
| Peculiar support equipment | | 12.3 | | | 12.3 |
| Data | | 21.6 | | | 21.6 |
| Training | | .6 | | | .6 |
| Total support requirements | | 34.5 | | | 34.5 |
| Initial spares | | 39.9 | 7.4 | | 47.3 |

AIR FORCE ONE REPLACEMENT PROGRAM—GENERAL BASELINE REQUIREMENTS AND COSTS—Continued

[In millions of dollars]

| | Fiscal year 1986 | Fiscal year 1987 | Fiscal year 1988 | Fiscal year 1989 | Total |
|---|---|---|---|---|---|
| **MilCon:** | | | | | |
| Maintenance and support complex | | 45.0 | | | 45.0 |
| Hangars both new aircraft | | | | | |
| Security system | | | | | |
| Automatic fire fighting system | | | | | |
| Hydrant refueling | | | | | |
| Strengthened ramps/taxiways | | | | | |
| Houses maintenance/supply | | | | | |
| Total program costs: | | | | | |
| RDT&E | 19.5 | 9.0 | 12.7 | .2 | 41.4 |
| Flyaway and nonrecurring | 280.0 | | | | 280.0 |
| Support requirements | | 34.5 | | | 34.5 |
| Initial spares | | 39.9 | 7.4 | | 47.3 |
| **MilCon** | | 45.0 | | | 45.0 |
| Total | 299.5 | 128.4 | 20.1 | 0.2 | 448.2 |

[1] Breakout of these costs not available until after source selection is completed.

I assume that we are talking about what is the required authorization, or have you already got the money?

General RANDOLPH. No, sir, we have got appropriations for 1986, but we have to come back to you, because it wasn't authorized. We have to work the authorization.

Mr. DICKINSON. All we are asking is what are we buying, and what is it going to cost, and how necessary is it? If they want to put a lot of bells or whistles, gadgets, gold faucets, so forth, on that thing, we would like to know about that, too.

The price tag was so—makes such a big blip on the scope of it, it didn't make a lot of sense.

Dr. COOPER. That is not just for two airplanes. It sounds like it is high, like you are buying an airplane, but it is the communications gear and the support that goes along with that to support the President of the United States wherever he is, worldwide.

Mr. DICKINSON. Tell me about that support business now.

Dr. COOPER. Communications support, his ability to communicate real time with the forces in a secure way, in a survivable way.

Mr. DICKINSON. When you said communications gear, you meant communications gear, and the support equipment was something else?

Dr. COOPER. No; I was talking about the support of that aircraft, though, wherever it goes, with its support equipment at Andrews, hangar at Andrews, and the new hangar.

Mr. DICKINSON. Have to build one for each bird?

General RANDOLPH. No, sir, it is one for the two.

Dr. COOPER. What I would like to propose is, however you think we should communicate with the committee, I could write to you or the chairman. I propose we give you the baseline program. We will tell you exactly what we propose to put in the Air Force One in terms of equipment, and define for you what the R&D bill is, what the content is, and show you the dollars that go with it.

Our best estimate right now, and as we mentioned, much of this is going to be decided through the competition, and I think both contractors are going to give us bare-bones bids.

It is a matter of prestige for both aircraft manufacturers to have their aircraft being flown by the President of the United States, so I anticipate that we are going to get very good competitive bids in terms of what the airframe is going to cost us.

I would like to give you the baseline program and the dollars that go along with it, if I could, for your consideration.

Mr. DICKINSON. Write the letter to the committee, because the only reason I got personally involved was because that was a reprogramming, in the off-cycle thing, and I wouldn't sign off on it and neither would the chairman.

If you would do that, and we will know what we are buying, and I don't think anybody on the committee is predisposed to disapprove it. We don't understand why you come in with such a tremendously high figure, $99 million initially, just for R&D, that is a lot of money.

Mr. BATTISTA. Mr. Dickinson, just before the Christmas recess, the subcommittee took testimony from Secretary Latham, and it is on hold in the full committee. They were supposed to get back to us and provide some numbers.

The estimate for EMP hardening is high, if you talk to Bill Gramm, Acting Administrator of NASA right now, he did all of the EMP studies for the B-1 for less than $5 million.

One of his proposals was to EMP the B-52s, and the total cost here, you talk about the COM suites—on the command post, for example, we spent $500,000, EMP hardening the Bureau's computer, and a lot of the other parts of the COM system to 50,000 volts per meter.

We have done it before. There has got to be some benefit from the education and the experience. You talk about the prestige factor. The real fact is we got a heck of a Federal deficit problem on our hands.

Why couldn't you have taken two of the KC-10's off the line, the last two?

Dr. COOPER. We are going to get a better price as a result of competition.

Mr. BATTISTA. Those KC-10's cost about $35 million a copy, and Latham talks about $99 million a copy for a 747.

Dr. COOPER. The competition will lay out those numbers for us.

[The Air Force notes that the above KC-10 cost is stated in fiscal year 1976 dollars whereas the 747 cost is in then year dollars. The comparions in similar year dollars would be $65 million for the KC-10 and $95 million for the 747]

Mr. BATTISTA. We have in hand right now a $35 million copy airplane under contract, you are buying 40 of them, and you could take two right off of that line and make them Presidential aircraft.

Competition, we didn't compete the C-18, you went directly to Boeing for the 707's on that.

General RANDOLPH. There was a competition for the Joint STARS, the C-18's were bought used.

Mr. BATTISTA. You could look at used aircraft here. There is that prestige factor——

Mr. **Dickinson**. You wouldn't want a President driving a second-hand automobile.

Mr. **Battista**. It was driven by a little old commander.

Mr. **Dickinson**. Give us what the breakout is, so we can say, OK, we will buy this, but we think this is unreasonable and the committee will work on it later.

Mr. **Badham**. I think it would be wise to put in there, too, the things that you would have to do to upgrade communications in the present birds, too, that are already bought or paid for.

Dr. **Cooper**. We have done that, and that was an issue we had last year when we came over for the upgraded communication suites for the existing birds.

Mr. **McCurdy**. Air Force priorities, and I want a clarification here, and since you have your force projection chart up there, I thought this would be a pretty good place to start.

How high is the Air Force priority for the JVX, for the SOF mission, and the statement was made to me, well, if they are built, yes, I would like to have some.

Dr. **Cooper**. That is correct, if it came down to the Air Force going it on its own for the JVX, it would not fare high in our list of priorities. We have a very minimal amount of money in our budget for that. We are not the lead service.

We want to take advantage of the JVX capability, but ours is not the primary mission for the JVX.

Mr. **McCurdy**. Since you don't have much money in it, do you have much impact as far as the requirements such as the range?

Dr. **Cooper**. Yes; we nave a very significant impact in terms of the engine that was chosen for the JVX. It is our range requirement that is the most pressing for the special operations forces.

Mr. **McCurdy**. Are you pleased with the decision on the engine?

Dr. **Cooper**. Yes, based on initial information, we are.

We would like to have a JVX that had a bit more range and are continuing to look at tradeoffs to achieve that goal.

Mr. **McCurdy**. General, do you agree with that statement on the engine?

General **Randolph**. I think the answer that we would prefer is that the engine would give us more range.

Mr. **McCurdy**. Does it have sufficient power?

General **Randolph**. The real issue is range. We can't get into specifics. We would like to have more range than that, but there is the cost issue, and it turns out that evidently the engine with greater range costs more money.

Mr. **Cooper**. We set an absolute rock bottom range, and this engine appears to meet that.

Mr. **McCurdy**. What about the priority within the Department, and certainly within the Air Force on the C–17, is that a high priority? Where is the Air Force's commitment on the C-17?

Dr. **Cooper**. It is high priority, and it is funded in our budget. There are a lot of things that are not funded in our budget that we would like to have.

Mr. **McCurdy**. The budget you submitted is not the budget you are going to get.

Dr. **Cooper**. We don't want to get into trading off in our budget. That is a losing proposition to trade one against the other.

Mr. McCurdy. I am curious as to the issues of—what is the issue for the C-17, life cycle costs, maintainability, survivability, are you going to indicate that the cost of keeping the C-5 by rewinging and potentially re-engining in the future, the C-141 retirement—I mean, where is the priority here?

Is this something the Air Force is going to fight for?

Dr. Cooper. Absolutely.

Mr. McCurdy. What is your cost if you stretch it for a year?

Dr. Cooper. Zero the production? The primary cost is that the operational capability is delayed by a year. That is the thing we need to keep in front of us. There is no good programmatic reason to slip the C-17.

I recognize the affordability issue as well as anybody. First and foremost we lose the operational capability, and that is why we are building the C-17.

We believe we need that capability. So, No. 1, that is the cost, that the IOC is slipped by a year. Our best estimates right now are that if you zero the production moneys, and I assume that is what you have in mind——

Mr. McCurdy. I am not suggesting that. I am asking you what that would do to it?

Dr. Cooper. My assumption is that there would be no production funds this year. If you adjust the program to slip at 1 year, it would be on the order of $1 billion-plus in terms of out year costs.

What you pick up there is another year of overhead that you don't otherwise have to pay. You also have some impact on the R&D program.

Mr. McCurdy. Well, are you—has the Air Force made a decision as to unsolicited bids and proposals as far as further C-5's?

Dr. Cooper. We are not interested in procuring additional C-5's.

Mr. McCurdy. I wish you would have made that statement 2 years ago. That is history. I think we made a mistake by procuring the additional C-5B's, Dr. Cooper.

Dr. Cooper. That statement was made in the interest of getting the near term capability, and along with it came 44 additional KC-10's, as you recall. The package is the 50 C-5Bs, and the additional——

Mr. McCurdy. I understand that, but now you require more tankers and you have a lot of other problems in the long term, plus I think that you are missing your best argument on the maintenance costs.

The reason I am familiar, I have a MAC training base in my District, where they have the 141's, and the C-5's, and the C-5 costs are incredible on maintaining that aircraft.

General Randolph. The number I have mentioned is ball park, about $6,000 an hour to fly a C-5B, about $3,000 an hour to fly a C-17.

Mr. McCurdy. Another program. It happens to be the same contractor, the F-15E. Tom, you and I argued on this one in the past.

I still, for the life of me, cannot understand where you need the F-15E when you are moving rapidly into the development of other systems, that are stand-off capabilities, and whether we can afford in this tight budget cycle to prolong, or to take a bird not designed for that and retool it or come up with a new mission, and of course, my bias is, you are trying to keep the production line open, but I still question the relative utility of that decision.

Dr. Cooper. It is not really a new mission. It is a mission that has always been there that we were deficient in.

Mr. McCurdy. The mission requirement may be there, but the bird was not designed to perform that mission.

Dr. Cooper. That is true. The original F-15 was designed as an air superiority machine.

I would like to talk about keeping the production line open. That is not the reason we made the decision, but that is a collateral benefit.

In my opinion, one of the nice things, one of the solid things about the Air Force tactical fighter program is that we are not procuring a large number of types of tactical fighter aircraft.

We have the F-15, and the F-16, and from a logistics point of view, that is a good thing for the Air Force, because we just have those two types of aircraft, along with the F-4's. I think it would be a mistake to close down the F-15 line, because that leaves the Air Force with one fighter production line. If we got into a time of crisis, that would be a bad situation from an industrial base point of view.

Mr. McCurdy. Aren't you in competition on the Advanced Tatical Fighter?

Dr. Cooper. We are, but the ATF will come in the inventory in 1995 and with the budget situations, more probably it will be later than that, so we are talking about living with the aircraft we have in terms of production for another decade.

I think it would be a mistake to close down the F-15, and not build aircraft for aircraft's sake. We have valid missions for both these aircraft.

Mr. McCurdy. You can find a mission for almost anything.

Dr. Cooper. We are not looking for the mission. That mission between what we can reach today and in the F-111 era, I mean, that is a target——

Mr. McCurdy. Mine is more of a tactical question, Dr. Cooper, and from the strategy of performing that mission, when you develop the standoff weapons, JTACMS and other nonpiloted vehicles and weapons, isn't there a redundancy here, and you are keeping a line open, and we get into the same problem.

We keep the lines open until we automatically have the next one on, and we stretch the ATF, and if you made a decision on that, could you not dedicate the moneys to that?

This line goes on forever, the dollar lines. The investment itself in the aircraft is just incredible.

Dr. Cooper. What you are offering is a bird in the bush for one in the hand. I don't want——

Mr. McCurdy. You want both? That is what this budget says. You got both. There is no risk.

Dr. Cooper. At the point in time when the ATF is a reality, and the ATF starts coming off the production line, that is the point in time we can shut down another production line, but given the uncertainties of the budget, and technical uncertainties, I wouldn't want to close that down.

Mr. McCurdy. We are going to sit here 3 years from now with the same argument, on the B-1, on every single line, you are saying we don't want to take any risk in here, we are not going to go any period at all without a hotline on any single weapon system, and the cost is eating us alive.

That is my point. Tell me where I am wrong.

Dr. Cooper. I have to agree with you. We do not want to take a risk in closing down one production line and leaving our Nation without an ability to surge. I think that would not be good stewardship of the taxpayers' dollar or of our defense posture.

Mr. Darden. I didn't even hear the F-20 mentioned in any of this discussion.

Where does that stand?

Dr. Cooper. That is a different discussion, and I would be happy to take that on. We are involved right now in a competition for upgrading and modernizing our air defense force, and the F-20 is one of those competitors.

Mr. Darden. OK.

Mr. McCurdy. The Air Force is not fighting this by itself. You do have warm production on the F-18, some F-14, I mean, there are lines open, and I realize—but does a decision that is made have to automatically terminate the line?

Can they not keep the tooling capability? Do you have to have the long lead in everything that you are maintaining? What is the cost rather than devising, or doing some gymnastics to get to this next mission, and there is a lot of redundancy here?

What is the cost of keeping that, the tooling, on hold?

Dr. Cooper. I don't think there is any cost, after you have stored it, of keeping the tooling on hold. The cost would be of drawing the line down and starting it up at some subsequent date. There would be a tremendous cost with that.

The reason we are proposing the F-15E is not to keep the F-15 production line open. It has that collateral benefit. We think there is a valid mission for the F-15E.

Mr. McCurdy. At some point in time, do you not agree—I just heard the Budget Committee, I have been over there for a while, and the Budget Committee is now talking about a freeze on outlays, an outlay freeze, but potentially some revenue.

Do you realize what an outlay freeze would do?

Dr. Cooper. It is devastating.

Mr. McCurdy. I am going to have to make a decision at some point in time, and I am telling you that if we don't get some help from that side——

Dr. Cooper. Don't ask us to come over and tell you the threat has gone away. If you need to make the decision for budget reasons, we understand that.

Mr. McCurdy. We are not saying the threat has gone away, either. That is not what I am asking you. I am asking you, based upon the existing threat, and the constrained budget that we are operating under, where is it that if there is some risk, where is the least dangerous risk for this country to go?

Dr. Cooper. I can't give you a one-word answer for that.

Mr. McCurdy. You could give us a budget for it. It sure would help.

Dr. Cooper. We are giving you a budget.

Mr. McCurdy. You will come back later and say, we are going to have to resubmit it to you in the next 3 weeks.

We have to report a budget out of here and have a markup. Are you going to leave it up to the Congress to make these decisions for you again? It is safe for you politically, but it doesn't help the country.

Dr. Cooper. At this point, the answer to that is yes, but with the dollars we have been hearing coming out of our budget, I wouldn't know how to tell you to begin to do that in a piecemeal fashion.

We would have to reroll this whole budget and go through our priorities and do it in a balanced sort of way. You can't reach those dollars by taking out one or two systems like you are proposing.

Mr. McCurdy. Why are we even having hearings? If this is the game we are in again, that——

Dr. Cooper. Our budget is structured against what we perceive to be the military need, and with the dollars that we have been given by the administration, this is the balanced program that we are submitting.

If you are telling us there is a new bottom line that is significantly different, I can't tell you how to reach that in "onesies" and "twosies" by taking programs out. It took us a year to put this together.

If you are telling me that the top line has to come down, I recognize reality. We don't even know how to begin to do that at a witness table.

Mr. McCurdy. Are there contingencies being made or developed over in the building to do this? You are talking about risk. The risk of closing down one line is a lot less than the risk of playing this political game we are playing, where you don't develop a budget, and leave it up to the piecemeal approach, which is far more threatening to our national security than looking at the options of making some priorities and making some decisions around here.

Mr. Dickinson. Has the Budget Committee given us a number yet?

Mr. McCurdy. They will soon.

Mr. Dickinson. They didn't last year.

Dr. Cooper. This is our first appearance with our budget. Before we even get a chance to present our budget and show you the balance, you are asking us to tear it apart.

I ask for at least an opportunity to present our budget, go through the rationale we used in putting it together, and we recognize the fact over the next few months, we are going to have a dialog with you, but I am not prepared to fold my tent today and start offering up programs for cuts.

Mr. Darden. Mr. Badham.

Mr. Badham. I would like to ask a question about the B1-ATB thing in an unclassified form. Dr. Hicks has been quoted in the newspapers as saying that the comparative costs of ATB and B1-B are only varied about 2 to 3 percent more for ATB, when both aircraft are priced in constant dollars.

Now, I think it is essential that unclassified information on that be made available to the Congress, and to the public so we don't get all the superspeculative horror stories from Dale Van Ata and company, and would you comment on such information that can be disclosed concerning the cost of the ATB Program and the Air Force's position so strongly against continuing the B-1?

Dr. COOPER. I am aware of Dr. Hicks' comments, but we can't comment on it at this point. That issue is being discussed in the Department now, whether we should release further information on comparative ATB and B-1 costs.

Mr. BADHAM. There is nothing you can do for us in an open session?

Dr. COOPER. The program is on schedule, and we anticipate that we will reach an operational capability in the early nineties.

Mr. BADHAM. Do you agree with that figure that was quoted in the paper?

Dr. COOPER. I can't comment on it right now.

Mr. BADHAM. I am a follower, and I would like to put together some of the incorrect speculative information put out by people who ought to know better.

Dr. COOPER. There may be something forthcoming in the not-too-distant future, but right now, we just have no comment.

Mr. BATTISTA. Mr. Badham, if we might, that is not the worst part of this whole saga on national security leaks, and we might want to get together and talk about something that is an order of magnitude worse.

Mr. BADHAM. All right, I think it is time.

Mr. DICKINSON. Mr. Chairman, let's meet at 1:45. That is, without the witnesses.

Dr. COOPER. Hope it is nothing we said.

Mr. DARDEN. Without objection, we will meet at 1:45 over here, and open it at 2.

Mr. BATTISTA. It is real genuine, Mr. McCurdy's concern, not in the best interests of the country to sit at the witness table and try to restructure a program. It is equally as bad as trying to write a defense bill on the floor of the House, but we have had a year to do it.

Last year, the JTIDS, the Navy had to have TDMA, it was a waste of money, and now they are with you and saving money. Electronic warfare, you all agree that the program is terrible.

We agree it is terrible.

Dr. COOPER. Don't put words in our mouth.

Mr. BATTISTA. All right, you said it has problems, we know it has problems. Nobody should go into the year 2000 with some of that junk, and yet, we are going to do it if we commit to this program. Yet, you can't help us with it.

F-15, you don't want a capability to go away, we could protect the tooling—we have F-16's that do the air-to-ground mission very well, borne out by the Israeli experience and your own experience.

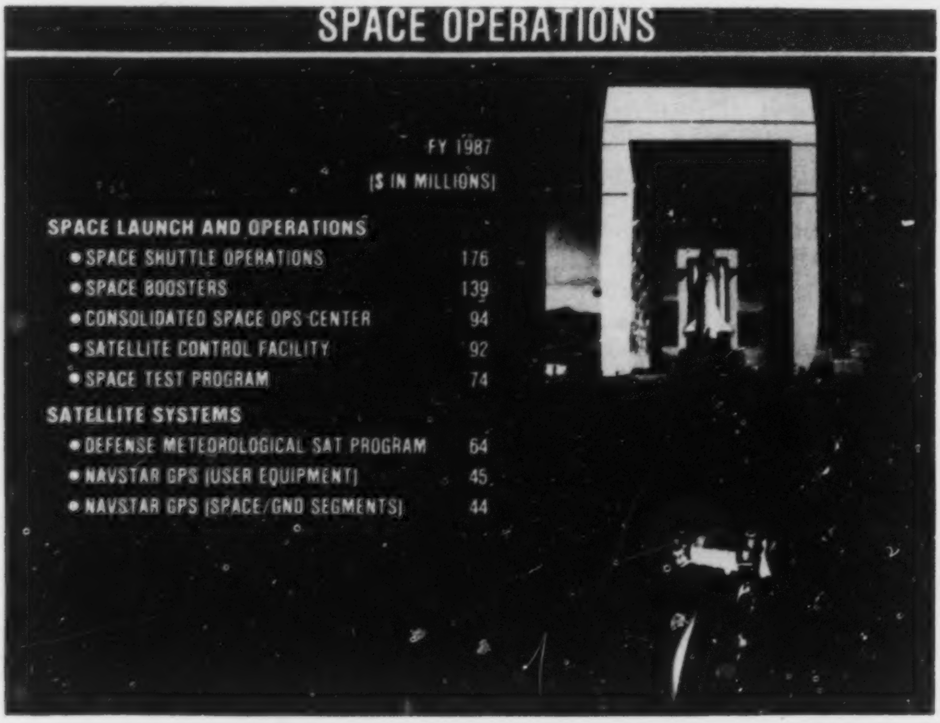
I mean, there are alternatives that will still meet the requirement, maybe to the 96-percent level, for substantially fewer billions of dollars. Yet, we have to work in a vacuum, and it is not your fault.

There has got to be a better way to do this. Between now and the 13th, we are going to make a program up for you, that is not the best way to do it.

Dr. Cooper. We understand that, and I am not trying to be short on our answers, but we don't have a priority list.

Mr. Darden. Gentlemen, I think we have established this. Let's move right along.

General Randolph. Thank you, Mr. Chairman.



SPACE OPERATIONS

| | FY 1987 ($ IN MILLIONS) |
|---|---|
| SPACE LAUNCH AND OPERATIONS | |
| • SPACE SHUTTLE OPERATIONS | 176 |
| • SPACE BOOSTERS | 139 |
| • CONSOLIDATED SPACE OPS CENTER | 94 |
| • SATELLITE CONTROL FACILITY | 92 |
| • SPACE TEST PROGRAM | 74 |
| SATELLITE SYSTEMS | |
| • DEFENSE METEOROLOGICAL SAT PROGRAM | 64 |
| • NAVSTAR GPS (USER EQUIPMENT) | 45 |
| • NAVSTAR GPS (SPACE/GND SEGMENTS) | 44 |

We will switch to the world of space operations here. This particular line discusses space shuttle operations, development spacecraft, the money that we would have to pay to do the shuttle launches.

I recognize that since the *Challenger* tragedy, we have been working the problem of what do we do with NASA. Hopefully, we will have some information to present to the Congress in the near future.

Mr. Darden. Do you anticipate a supplemental report of some type?

General Randolph. Yes, sir, we are working on that. I am not sure of the form. We have been in daily contact with the NASA people, but the discussions will center around expendable launch vehicles to help augment and carry us over until the shuttle is in a position for launch.

Mr. Darden. It might be well to schedule a special hearing on that later on.

General Randolph. The NAVSTAR GPS Program multiyear contract was started about 3 years ago and we promised the Congress we would save $210 million. I am pleased to report we are exactly on track and that contract is moving along quite well.

It is my view when you talk about operational spacecraft, multiyear procurement is the only way to buy those. You buy them in small numbers, and to save money you need to commit to a block of spacecraft and go out and account for that block.

Mr. DARDEN. How is the new space command working?

General RANDOLPH. Extremely well. They are now controlling their first operational spacecraft, the GPS. We are putting the capability in the Consolidated Space Operations Center, and Gen. Bob Herres has put his staff together and as he reported 2 weeks ago, it is going along quite smoothly.

Space is something that is part and parcel of almost everything that we do in the military, and has been that way for a number of years, so I guess I am always mystified when we talk about the militarization of space. There is nothing we are doing differently today than we have for a number of years.

Mr. McCURDY. I have a question on the Shuttle Program—satellites. You may not be able to answer this in open session, the launch vehicles, the birds that were designed for that, they are not easily transferable.

Those that were designed for the shuttle cannot be retrofitted to fit on the expendable launch vehicles—I am sorry, easily, so is not the issue that is facing you the amount of time that is down, the downtime on the shuttle, and at what point in time does that become a critical factor, late summer, fall, the first of the year?

There is a cut point. At what point did it start to cramp you?

General RANDOLPH. I don't want to use the term "critical" just yet. Anything above about a 6-month delay is a problem.

Mr. McCURDY. Six months from now?

General RANDOLPH. Six months from January, and it appears from everything that I can see that there is absolutely zero hope of achieving only a 6-month delay. It looks like it will be a year or more.

Mr. McCURDY. Is there any way to accelerate the Expendable Launch Vehicle Program? See, I sense that that is not the answer, because the problem is the payload, and if the payloads have been configured now to fit the shuttle, and new payloads are rarer than some of the others that had the holster or whatever it was that fit around it. What are the options?

General RANDOLPH. It really depends on the payloads.

There are some payloads that can be launched either with the shuttle or with an expendable launch vehicle. We have designed payloads to take full advantage of the 15 x 60 ft available payload bay of the shuttle; and, therefore, that is larger than any of the earlier expendable launch vehicles.

We came to the Congress a couple of years ago and asked for the Complementary Expendable Launch Vehicle capable of lifting just about the same amount of weight and volume that a shuttle can.

Not all of our payloads are configured to do that vertical thrust as opposed to the approach used in the shuttle.

There are some that can go either way. We are looking at how much would it take to move some of the payloads off the shuttle and put them on expendable launch vehicles as part of the discussion.

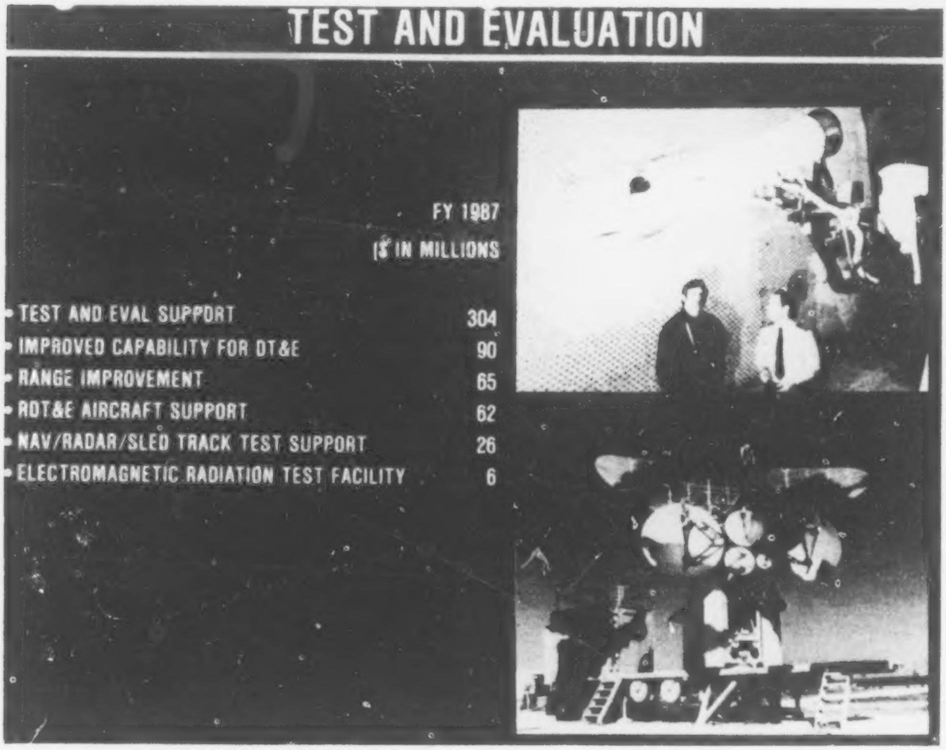
We must eventually get the shuttle back into space, because we have to have it. There is no option to us, and the expendable launch vehicle is just that: A complement to the shuttle, not a replacement.

Mr. McCurdy. When is the first launch from Vandenberg scheduled?

General Randolph. The first launch of the shuttle was scheduled for July of this year. Obviously, that is not going to happen.

Mr. Darden. General, we stopped you very briefly. Mr. Battista and I were trying to decide, is Space COM a unified or specified command?

General Randolph. A unified command. It is the United States Space Command, a unified command, and there are Army and Navy people in the command right today.



## TEST AND EVALUATION

| | FY 1987<br>($ IN MILLIONS) |
|---|---|
| • TEST AND EVAL SUPPORT | 304 |
| • IMPROVED CAPABILITY FOR DT&E | 90 |
| • RANGE IMPROVEMENT | 65 |
| • RDT&E AIRCRAFT SUPPORT | 62 |
| • NAV/RADAR/SLED TRACK TEST SUPPORT | 26 |
| • ELECTROMAGNETIC RADIATION TEST FACILITY | 6 |

Mr. Darden. The second manner—this is unrelated to what we just mentioned—we had a hearing in Research and Development about 3 weeks ago. We heard a presentation by a number of people about our test and evaluation programs throughout the branches of the service, and including testimony from General Hollingsworth, who was quite outspoken about some inherent flaws that he perceived in our test and evaluation process, and if even 25 percent of what the General asserted is correct, we have serious problems in test and evaluation.

And it was mentioned and suggested by a number of persons at the hearing that perhaps we ought to have an independent DOD test and evaluation process and take this out from under the individual services.

How would you respond and comment on that?

General **Randolph**. There are two pieces to the test and evaluation. One is development, test and evaluation, which we in the development and acquisition community do, and that is to prove that the product that we are putting together does what it is supposed to do—at least to our satisfaction.

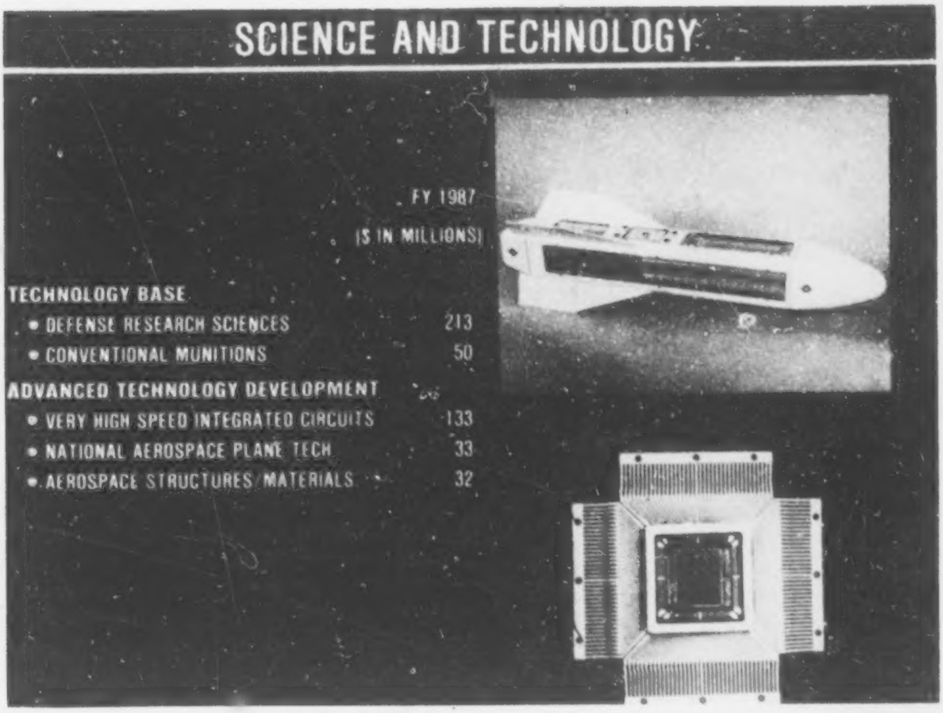
When we are finished with that, then we turn that over to an independent tester, and that is called the Air Force Operational Test and Evaluation Center, and they do an independent test of the system and work very closely with the DOD test and evaluation office headed by Mr. Krings. Mr. Krings sets that policy, makes sure the testing is done to his satisfaction, and ensures the test plans are laid out to make sure that he can attest to the Secretary of Defense that it meets the operational need.

There is an independent test of a system before it is allowed to go into production.

Mr. **Darden**. The independent test capability is under the Air Force?

General **Randolph**. Yes, sir, it is under the Air Force in the sense that we use Air Force resources, but all of the policies and the requirements are established within the Director of Operational Test and Evaluation, Mr. Krings, so he handles that independent test function.

All this is the housekeeping that goes with the test and evaluation. Each program pays for the test and evaluation, and this runs



## SCIENCE AND TECHNOLOGY

| | FY 1987<br>($ IN MILLIONS) |
|---|---|
| **TECHNOLOGY BASE** | |
| • DEFENSE RESEARCH SCIENCES | 213 |
| • CONVENTIONAL MUNITIONS | 50 |
| **ADVANCED TECHNOLOGY DEVELOPMENT** | |
| • VERY HIGH SPEED INTEGRATED CIRCUITS | 133 |
| • NATIONAL AEROSPACE PLANE TECH | 33 |
| • AEROSPACE STRUCTURES/MATERIALS | 32 |

I will talk about the science and technology, and I will not discuss this very long, because General Bob Rankine, our technology type, is going to come right after me and discuss details.

The very-high-speed integrated circuit [VHSIC] technology is moving along quite well. We had our first operational insertion of this technology into a piece of operational equipment, a jamming pod, and we took a transmitter control assembly, replaced 21 electronic cards with 8 cards and improved the reliability, according to our calculations, by an order of magnitude times 10.

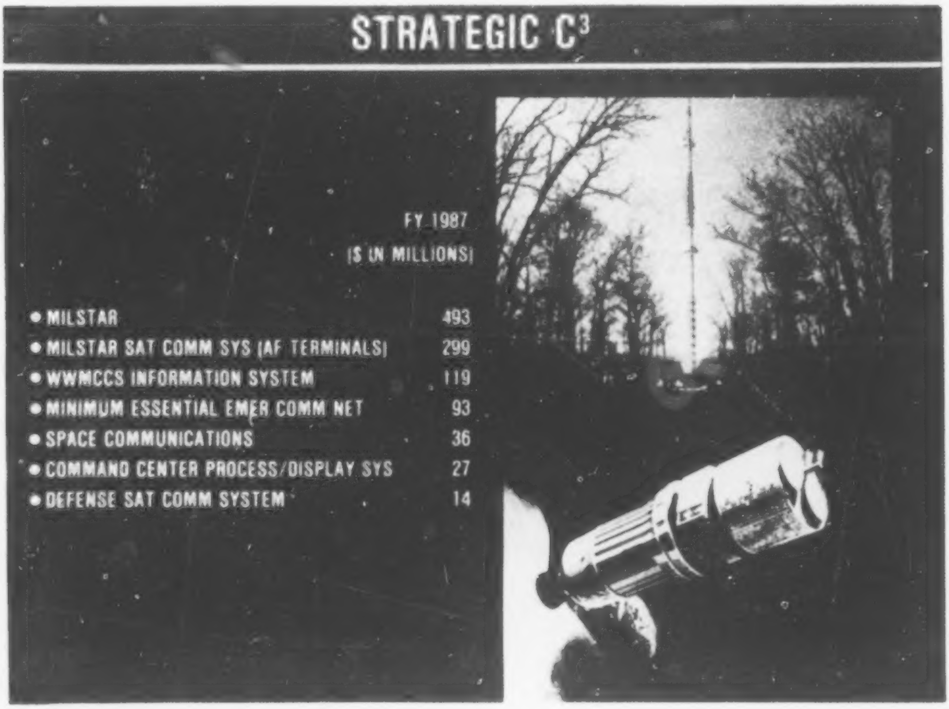
So, it is a major step forward and helps with the maintainability.

Mr. McCURDY. How is that coordinated? What is the framework for the decisions as to what things will be retrofitted?

General RANDOLPH. We have a committee, and they look at the VHSIC insertion and what are the top candidates. They look for the bad actors, the ones where we are having the most reliability problems, and this happens to be one of those, Mr. McCurdy.

Mr. McCURDY. Is that servicewide?

General RANDOLPH. The VHSIC insertion is servicewide. It applies to all of the services. It is all in the Air Force budget.



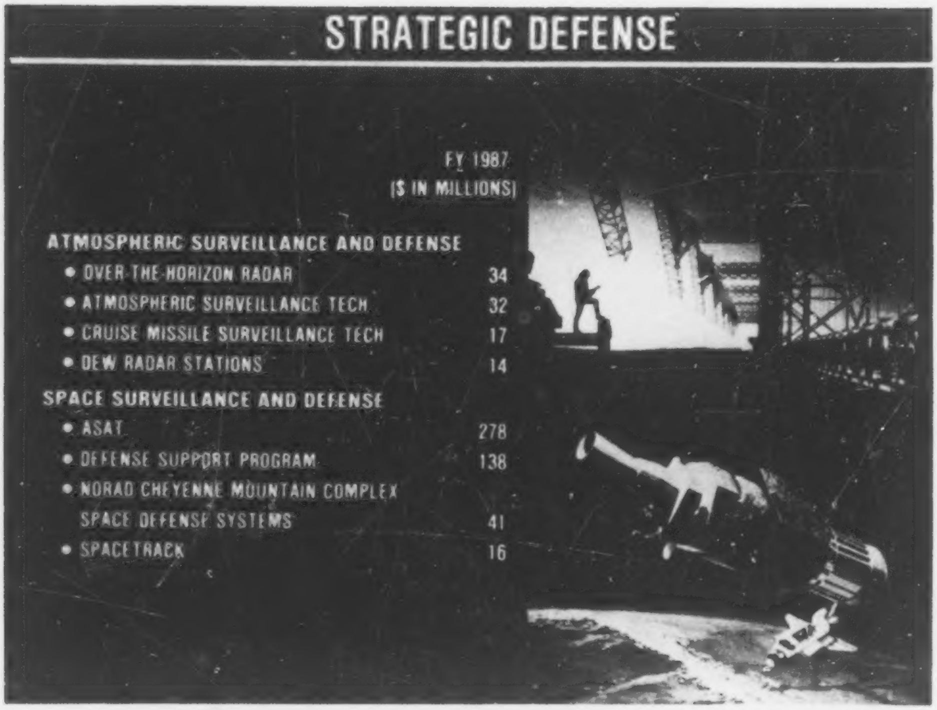
STRATEGIC $C^3$

| | FY 1987 ($ IN MILLIONS) |
|---|---|
| • MILSTAR | 493 |
| • MILSTAR SAT COMM SYS (AF TERMINALS) | 299 |
| • WWMCCS INFORMATION SYSTEM | 119 |
| • MINIMUM ESSENTIAL EMER COMM NET | 93 |
| • SPACE COMMUNICATIONS | 36 |
| • COMMAND CENTER PROCESS/DISPLAY SYS | 27 |
| • DEFENSE SAT COMM SYSTEM | 14 |

In Strategic C3, we want to be sure we have secure, survivable, and antijam communications.

Included in that, of course, is the Defense Satellite Communication System [DSCS] spacecraft, long-haul communications. We are proposing to do a multiyear procurement of some of those.

The constellation is healthy, doing well.



## STRATEGIC DEFENSE

| | FY 1987 ($ IN MILLIONS) |
|---|---|
| **ATMOSPHERIC SURVEILLANCE AND DEFENSE** | |
| • OVER-THE-HORIZON RADAR | 34 |
| • ATMOSPHERIC SURVEILLANCE TECH | 32 |
| • CRUISE MISSILE SURVEILLANCE TECH | 17 |
| • DEW RADAR STATIONS | 14 |
| **SPACE SURVEILLANCE AND DEFENSE** | |
| • ASAT | 278 |
| • DEFENSE SUPPORT PROGRAM | 138 |
| • NORAD CHEYENNE MOUNTAIN COMPLEX SPACE DEFENSE SYSTEMS | 41 |
| • SPACETRACK | 16 |

I will now switch to strategic defense. The thing that is of interest to the committee is the antisatellite work that we have in that particular line. Of course, we are proposing to continue with the development of that system.

Mr. McCURDY. General, what was the loss of TDRS? I mean, we have had two bad pieces of luck on that.

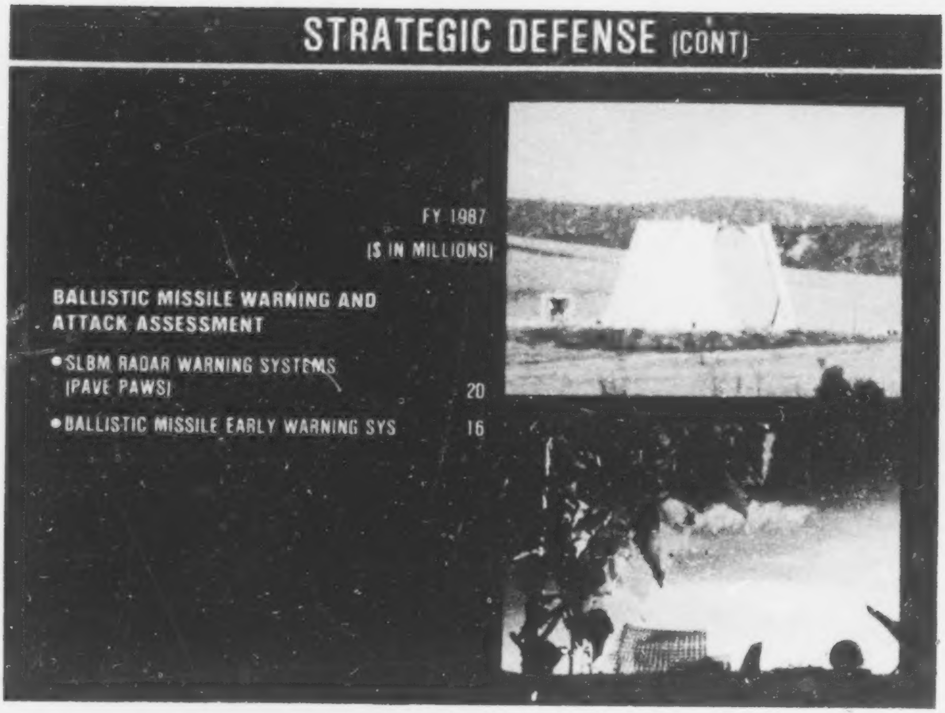
General RANDOLPH. The first TDRS, the IUS screwed up and we had to use internal thrust to boost it into its proper orbit, and as a result of tossing it around, it doesn't work the way it should.

The second TDRS is lost. [Deleted].

Mr. McCURDY. I was curious if we were accelerating to try to replace it.

General RANDOLPH. When we restart the shuttle launches, that will be one of the first ones we propose to launch.

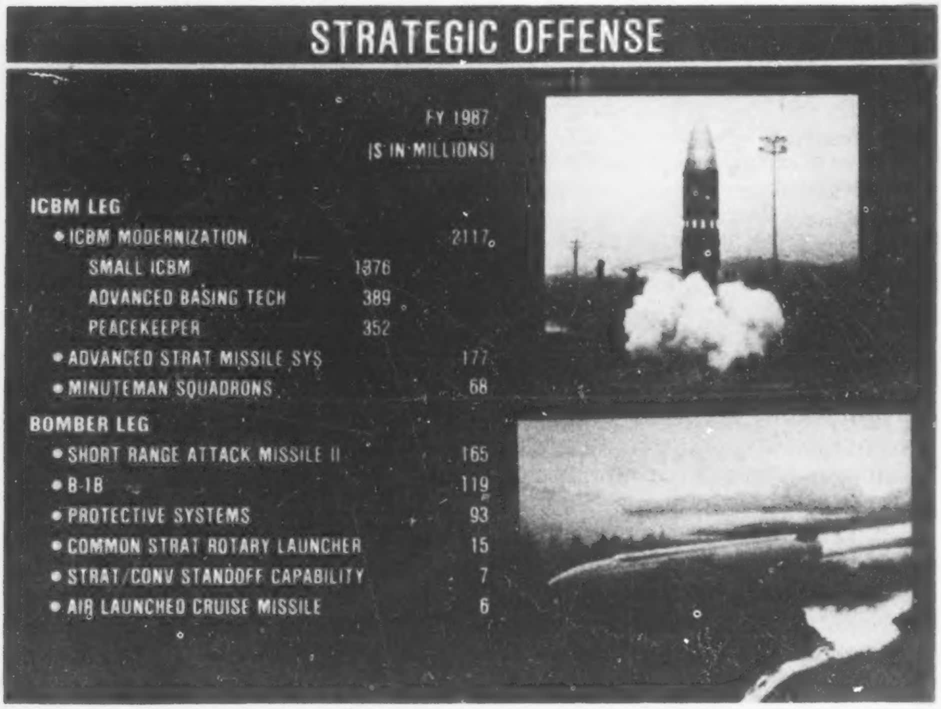
Antisatellite work: we had planned to go into production with the ASAT, and we determined that we were not ready to go into production, so you will see in our fiscal year 1987 request that we would like to continue doing work, particularly in the producibility area. That is what a large part of that money is for.



## STRATEGIC DEFENSE (CONT)

| | FY 1987 ($ IN MILLIONS) |
|---|---|
| **BALLISTIC MISSILE WARNING AND ATTACK ASSESSMENT** | |
| • SLBM RADAR WARNING SYSTEMS (PAVE PAWS) | 20 |
| • BALLISTIC MISSILE EARLY WARNING SYS | 16 |

Strategic defense: PAVE PAWS sites at Robins AFB, GA and the other one in Goodfellow, TX will be completed in fiscal year 1987. Also, these are minor upgrades to the Robins' radar and the existing radars at Otis Air National Guard Base, MA, and Beale AFB.



## STRATEGIC OFFENSE

| | | FY 1987<br>($ IN MILLIONS) |
|---|---|---|
| **ICBM LEG** | | |
| • ICBM MODERNIZATION | | 2117 |
| SMALL ICBM | 1376 | |
| ADVANCED BASING TECH | 389 | |
| PEACEKEEPER | 352 | |
| • ADVANCED STRAT MISSILE SYS | | 177 |
| • MINUTEMAN SQUADRONS | | 68 |
| **BOMBER LEG** | | |
| • SHORT RANGE ATTACK MISSILE II | | 165 |
| • B-1B | | 119 |
| • PROTECTIVE SYSTEMS | | 93 |
| • COMMON STRAT ROTARY LAUNCHER | | 15 |
| • STRAT/CONV STANDOFF CAPABILITY | | 7 |
| • AIR LAUNCHED CRUISE MISSILE | | 6 |

In strategic offense: We will have a full session on that area. In terms of programs, these are some of the best run programs we have got in the Air Force. We started with the small ICBM in 1983 with no program at all and have gone through a very aggressive program, and we are ready to go into full-scale engineering development in December. All of the preparatory work to doing that is moving along quite well.

Mr. DARDEN. Mr. Badham.

Mr. BADHAM. Could I ask you, and can you answer it—we are going to be talking about comprehensive test ban treaty forcing on the House floor and bring up the small ICBM, and do we have a warhead for that?

General RANDOLPH. The warhead is in design right now, but the answer is, the warhead is tracking along with the rest of the program.

Mr. BADHAM. If we were to have a comprehensive test ban treaty today, or tomorrow, we wouldn't have a warhead, would we?

General RANDOLPH. I would prefer not to address that. I would like to take that for the record, because I am not an expert in warhead development.

[The following information was received for the record.]

### COMPREHENSIVE TEST BAN TREATY IMPACT ON SICBM

The SICBM warhead development is concluding the warhead concept feasibility phase. Two baseline candidates, the W87 (Peace-keeper) and the W88 (Trident II) warheads have been studied along with multiple excursions to these designs.

If W87 baseline is selected, additional underground tests (UGT) may not be required. The determination will depend on how different the SICBM warhead requirements are than Peacekeeper's. Once requirements are defined, UGT requirements will be determined.

If the W88 baseline is selected, UGT would be required. The W88 candidate uses insensitive high explosive (IHE) for the SICBM application. IHE is not used in the Navy version and [deleted] UGTs are required for each modified system to ensure the credibility and effectiveness of our nuclear deterrent. [Deleted].

If a Comprehensive Test Ban Treaty (CTBT) is imposed, it would certainly influence the selection of the SICBM warhead in that the W87 would probably be selected. Selecting the W88 warhead may be more difficult with CTBT because of [deleted].

A CTBT would prevent us from optimizing a modified warhead for the SICBM and may require that we pay a penalty in terms of military effectiveness, safety, reliability, survivability and costs.

As an engineer, I can't imagine that we could develop it without testing it.

Mr. **Badham**. That was pretty close to the right answer, General. Thank you.

General **Randolph**. The advanced basing technology takes a look at some more survivable basing modes for the Peacekeeper.

Congress hasn't stopped at 50 right now, and we believe the request is to take a look at our more survivable basing modes, and we are in the process of doing that.

Short-range attack missile——

Mr. **Darden**. Give us a breakdown here for the record.

General **Randolph**. I am sorry. Small ICBM money, full scale engineering development.

Mr. **Battista**. Provide the breakdown of those funds, on the advanced basing, specifically.

[The following information was received for the record:]

### Advanced Basing

Advanced Basing Technology is broken out as follows:

| | *Million* |
|---|---|
| Deep Basing | $20 |
| Other modes: | |
| Conceptual Design and Component Testing | 130 |
| Facility Design and Testing | 15 |
| Blast and Shock Testing | 60 |
| Concealment Testing | 65 |
| Environmental Siting | 25 |
| System Engineering | 74 |
| Total | 389 |

Dr. **Cooper**. We are going to have the module this afternoon that will develop all that for you.

## MAJOR RDT&E PROGRAMS

[S IN MILLIONS]

| | |
|---|---|
| SMALL ICBM | $1376 |
| C-17 PROGRAM | 612 |
| MILSTAR SATELLITE COMMUNICATIONS PROGRAM | 493 |
| ICBM ADVANCED BASING TECHNOLOGY | 389 |
| JOINT SURVEILLANCE TARGET ATTACK RADAR SYSTEM | 356 |
| PEACEKEEPER | 352 |
| TEST & EVALUATION SUPPORT | 304 |
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| SPACE BOOSTERS | 139 |

General RANDOLPH. Of course, the B-1B is just in testing. This is the wrap-up of the overview, not in any priority order, but about a third of the RDT&E budget, just to give you a feel for the numbers, and those are many of the programs that I know the committee is interested in.

That completes my discussion, Mr. Chairman, unless there are any further questions.

Mr. DARDEN. Put that chart back up. Give us a breakdown of how much money is in the first 100 programs and a little analysis of what these, the relative amounts—all right.

You have got how many programs, for example, over $1 billion?

General RANDOLPH. This list here adds up to roughly about $6 billion, actually a little bit less, so that is about a third of the RDT&E request.

Mr. DARDEN. About a third of the requests is in how many programs?

General RANDOLPH. This—small ICBM—is the only one that has a requests in excess of $1 billion, among the programs that we can discuss in this session.

Dr. COOPER. That is by dollar value, Mr. McCurdy.

Mr. BADHAM. Next time do them alphabetically.

Dr. COOPER. This is just by dollar.

Mr. MCCURDY. I would like the Peacekeeper down a little bit.

Mr. DARDEN. Anything in particular you want to say further?

Mr. MCCURDY. Let me ask a question. When I was in California, at the BMO, I asked the General there about the warhead on the small ICBM, and I thought it was his statement to me that was not a new warhead that we could use, that there was commonality, and the issue of testing was not as critical as some might suggest.

General RANDOLPH. It is not a new warhead but a modification to an existing warhead. I don't ascribe that we have to test it to the same degree as a newly developed system, but in my engineering judgment, any time you change something I like to see it work, and the warhead requires some modification.

Mr. McCURDY. The statement was made to me that this was amateur, or whatever the proper language is.

Dr. COOPER. The Small ICBM will use the same warhead as the Peacekeeper, the Mark 21RB, [deleted].

If you go to a yield different than what we are using on Peacekeeper, then that brings in the issue of testing, Mr. Badham.

Mr. McCURDY. I may come to a different conclusion than my friend, but I still think that that is a relevent question.

Mr. BATTISTA. On the small ICBM, have you reviewed the draft of the small ICBM study chaired by John Duetsch?

General RANDOLPH. The DSB study, I have not seen that, no.

Mr. BATTISTA. Any Air Force data indicating a change in requirements over what you have been giving us for the last 4 years in terms of the weight?

You would be better off with some pen aids, requirements for MIRVing, and so forth. I have had no one tell me the small ICBM is not doable within the 30,000 pound range, 30,000 to 39,000?

Dr. COOPER. Let me comment on that. If the question is, can we build a 30,000 pound class small ICBM, single warhead that will have military utility, the answer is, in our mind, yes, we can build a 30,000 pound missile, and it will have adequate range.

What you lose in the 30,000 pound class is the penetration aid capability.

If you ask what do we think the optimum size small ICBM is—one warhead, between 37,000 and 40,000 pounds which maintains the range at the 30,000 pound level and gives us some capability to carry pen aids.

Mr. McCURDY. Can you do it at 37,000?

Dr. COOPER. We believe we can do it at 37,000. We would like to bump up the weight to 40,000. That makes use of the existing boosters and does not change the diameter of the boosters we are using.

Mr. McCURDY. Thirty-seven is going to be the request?

Dr. COOPER. Where we are right now, doing minimal damage to the program, a relatively small increase in cost keeps the diameter of the boosters in the 37,000- to 40,000-pound weight class.

Mr. McCURDY. I don't think you will find any opposition to go to 37. That is within the requirements there.

Dr. COOPER. We do need statutory relief to do that.

Mr. McCURDY. To get 37,000?

Dr. COOPER. Yes. We can go up to 33,000. Beyond that, we need relief. That would be a prudent thing to do, if you are going to build a single warhead Small ICBM.

Mr. McCURDY. It sure beats 70,000 pounds. Don't come forward with a 70,000, three warhead. You will have real problems. We have been through that debate.

Mr. BATTISTA. You ought to get some unanimity of opinion coming out of the Pentagon, because right now if anybody is putting the Scowecroft Commission findings to rest rather quickly, it is these multiple opinions coming out of there that all of a sudden we need MX junior, 70,000 pounds, and politically, it won't sell.

Militarily, you can do it with a 37,000-, 33,000-pound missile. You are shooting the President's program right through the head with the stories coming out of the Pentagon.

Dr. **Cooper**. Talk technical for a moment, as opposed to programmatic; from a technical point of view the Air Force can build you any size missile you want above 30,000 pounds. We can build you a 40,000 pound class, 60,000 or 80,000. There would be some limitations, but as far as the technical merits are concerned, there is no technical problem with building different size missiles.

We want to be clear in the Air Force that we are supporting the President's program to a "t", and that was a hundred MX's, and the last 50 to be based in a more survivable basing mode.

We are supporting the single warhead Small ICBM in the 30,000-pound class and looking at alternate basing modes.

That was the recommendation that came out of the Scowcroft Commission; that is the program we have been on for the last 3 years, and that is the program that we are supporting.

Mr. **McCurdy**. Is that your alternate basing, 352, Peacekeeper?

General **Randolph**. Alternate basing is $389 million. That is for the various advanced basing modes.

Dr. **Cooper**. When the basing mode is selected late in fiscal year 1987, that money would be put against whichever specific basing mode is selected as a follow-on basing mode for Peacekeeper.

Twenty million of it is for deep underground work, but the bulk of it is for the selective basing mode.

Mr. **Darden**. General, go into a little preview of what we are going into this afternoon.

Dr. **Cooper**. Our next presentation, 15 or 20 minutes, from General Rankine has three programs: Manufacturing Technology, the Very High Speed Integrated Circuit Program, and a brief discussion of the National Aerospace Plane which has had high interest.

Mr. **Darden**. Last year, nobody could explain manufacturing technology, and Mr. McCurdy and I ran into a problem with that.

Mr. **McCurdy**. I learned more about it, and I wanted to ask a question on the small ICBM, a follow-up question, and that is, if Congress does nothing in the near future to change the weight of the small ICBM, will the Air Force propose a change within the 30,000-pound class?

I don't want to get into a situation where Hicks says 75,000, three warheads. Congress is saying 30,000 and people in the Air Force are saying 37,000 is where we need to be.

Dr. **Cooper**. The difference being, what Dr. Hicks talked about to us is the desirability of perhaps looking at a MIRV missile.

If we continue to talk about a single warhead missile, we are talking about 20,000 and 40,000 pounds. If you talk about MIRVing, that is a whole separate issue.

Mr. **McCurdy**. If we don't go to MIRVing, when will the Air Force make its recommendations that you go to 37,000 to 40,000 or whatever it is? When will we see some numbers in print as to exactly what you think the alternative is within that 30,000-pound class? Is there something ongoing?

Dr. **Cooper**. No formal request, but what we would tell you if you are interested——

Mr. **McCurdy**. I think what this subcommittee will do is make a request that the Air Force provide those numbers, a basis for the study or the conclusions.

Dr. **Cooper**. We would be pleased to respond to that request.

Mr. **McCurdy**. Consider there will be a forthcoming letter from the chairman—not this chairman—that we get some response on that.

Do you expect that to take very long?

General **Randolph**. There is an existing report now that suggests the 37,000 pounds, but not a request by the Air Force to do that, but we think that is a prudent course of action.

Mr. **McCurdy**. We would like to make a request.

Mr. **Darden**. Getting back to this afternoon?

Dr. **Cooper**. Following that, a 15-minute presentation on the AMRAAM Program, and that would be followed by General Loh, who will talk about our theater programs including ATF. General Monahan will talk about LANTIRN and munitions; and General May will talk about our ICBM Modernization Program.

If time remains, General Randolph will talk a little bit more about space.

Mr. **Darden**. Do any members or staff have any comments or suggestions? Could you have someone cover the ASAT Program also?

Dr. **Cooper**. Now, Mr. Chairman, or later?

Mr. **Darden**. We got about 7 minutes.

Dr. **Cooper**. Let me comment briefly. As you may recall, out of the continuing resolution last year, there was a restriction placed on further ASAT testing against an object in space.

Our plan this year had been to test against an object in space. Right now, we are not permitted to do that because of the restrictive language in the CRA. We in the Department are currently discussing what alternatives we have in terms of continuing that program.

We have not yet taken a final position on it.

One of the options that we have would be to test against the radiated energy from a star as we did previously. Last year we had restrictive language that said until a certain date we couldn't test against an object in space, and we tested against a star and obtained very useful information from that.

General Randolph can talk about the production verification program.

Mr. **Darden**. In the remaining time, go into ASAT.

## SPACE DEFENSE SYSTEMS
## (ASAT)

- TWO-STAGE MISSILE WITH MINIATURE VEHICLE WARHEAD
- DETERS THREATS TO U.S. SATELLITES; PROVIDES CAPABILITY TO DENY SOVIET USE OF SPACE SUPPORT SYSTEMS
- ANTISATELLITE CAPABILITY AGAINST LOW ALTITUDE TARGETS
- FY 87: CONTINUE DEVELOPMENT AND TESTING

General **Randolph**. This is what the program is, and you are familiar with that.

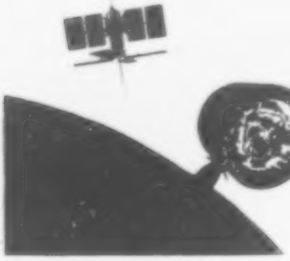
## SPACE DEFENSE SYSTEMS
## (ASAT)

($ IN MILLIONS)

| | FY 85 & PRIOR | FY 86 | FY 87 | FY 88 | TO COMPLETE | TOTAL |
|---|---|---|---|---|---|---|
| RDT&E | 1133.0 | 185.0 | 278.0 | 228.2 | 258.6 | 2095.3 |
| WPN SYS PROC | 101.9 | 34.5 | 30.5 | 350.4 | 1287.5 | 1804.8 |

FY 87
RDT&E REQUEST
$ 278.0

| | |
|---|---|
| • PRODUCTION VERIFICATION | 158.0 |
| • ASAT MISSILE DEVELOPMENT | 57.0 |
| • SUPPORT | 40.0 |
| • PMOC | 18.0 |
| • INSTRUMENTED TEST VEHICLE | 5.0 |



FY 87
WPN SYS
PROC REQUEST
$ 30.5

| | |
|---|---|
| • ASAT WPN SYS LONG LEAD | 28.5 |
| • BASE SECURITY SYSTEM | 2.0 |

SCHEDULE

| | |
|---|---|
| • COMPLETE TESTING | FY 88 |

This talks of the money and the breakout right here for how we would propose to use the money beginning in fiscal year 1987.

Mr. Chairman, earlier I said we had planned to begin production back in 1986, but we clearly were not ready, and the Under Secretary of the Air Force commissioned an independent review, and that review team took a look at the program.

"A," it was technically in good shape, and, "B," it was structured properly in the development area, but, "C," it needed to have more work performed in the area of producibility and, we needed to make sure we had an operationally capable system to go out in the field and have operators work that program.

As a result of that, we are now requesting money specifically to do that production verification, and we have delayed the production. This money that you see here is to actually initiate the long lead to start production in fiscal year 1988. The request also includes some additional development.

In addition, we took the Prototype Mission Operations Center [PMOC] and moved it from another command and control line into the ASAT line.

Mr. McCurdy. Why are you asking $100 million more?

General Randolph. I am sorry?

Mr. McCurdy. It is about $100 million from 1986 to 1987. What did you have in 1986, $199 million?

General Randolph. The 1986 program was specifically to do the development work, design work on the center, design work on the system, and to do test shots. We are in the process of doing that, in fact, right now.

This money here is primarily to do the production verification and complete the ASAT development work, and, in large part, tests.

Mr. McCurdy. How many tests?

General Randolph. We would propose three tests in the course of fiscal year 1987. Right now we are restricted from testing against objects in space. We can conduct tests, and that is what we are discussing within the Department. We can conduct tests to allow us to move the program forward without testing against an object in space.

Dr. Cooper. In the 1987 budget request, those moneys are not encumbered by the restrictions. They may be encumbered at the end of the year, but not right now. It is the 1986 dollars that are encumbered.

Mr. Battista. Where did you get $199.5 million in RDT&E last year? If I remember, your request was much lower than that. Is that carryover?

General Randolph. No, that is not carryover, and I think this chart is misstating what we had proposed to the Secretary of Defense. [Corrected slide shown.]

We have proposed that we reprogram some moneys from the procurement line into RDT&E, because we are not ready to go into procurement.

You are absolutely correct.

Mr. Battista. That number has not been approved?

General Randolph. That is not an approved number.

Mr. BATTISTA. This committee is not considering any reprogrammings?

General RANDOLPH. That is what Dr. Cooper is saying is under discussion in the Department of Defense.

Mr. BATTISTA. That is closer to $121 million?

General RANDOLPH. Yes.

Mr. BATTISTA. How does that impact your 1987 reprogramming?

General RANDOLPH. If we are not able to lay out the program, we are proposing we have a scale-down option where we would do less work in Fiscal Year 1986.

However, the key thing is that we make reasonable progress in the development activity.

Mr. BAYER. When will you be coming over with the Nunn-McCurdy breach on this program?

General RANDOLPH. There is an increase in unit costs for two reasons. We changed the number of units—and we would have to go into closed session to discuss why we did that—and we asked for increased money for verification, so the unit cost is going up.

March is the time we are required to notify you.

Mr. MCCURDY. Are there any breaches in the other major programs?

Dr. COOPER. Maverick.

General RANDOLPH. Because of the Gramm-Rudman cuts, and the difference is that in the Maverick Program, the Nunn-McCurdy breach is a 1-year breach, because we reduced the quantity in a single year.

Dr. COOPER. That one we put in the category of Gramm-Rudman-Hollings-McCurdy breach.

Mr. MCCURDY. Over here we call it McCurdy-Nunn breaches.

Mr. COOPER. That is technical where ASAT is due to a program restructure.

Mr. BATTISTA. You had already blown that budget?

Mr. COOPER. We took $200,000 out, because at the time the law was passed we were over-obligated.

Mr. BATTISTA. That is right.

Mr. DARDEN. This was about your most successful test.

Dr. COOPER. It was an astounding test.

General RANDOLPH. Friday the 13th we did the test, and one of the folks asked me, why did we pick Friday the 13th, and my response was, "Superior confidence."

Mr. DARDEN. For the record, would one of you give the specifics: how far away it was, how fast things were going?

Dr. COOPER. We will put that for the record.

[The following information was received for the record:]

### ASAT TESTING

The target destroyed was Space Test Program satellite P78-1, an old experimental spacecraft past its useful life. It was intercepted at an altitude of [deleted] over the Western Test Range. Verification of impact was confirmed by using several independent methods: [deleted]. Other specifics are provided below:

Satellite speed: Approximately 18,000 mph.
F-15 take-off: 15:42:00 EDT.
Missile launch: 16:36:30 EDT.
MV deployed: 16:41:46 EDT.
Time of intercept: 16:42:46 EDT.

Target acquisition distance: Approximately [deleted].
Number of MV motors fired: [Deleted].

Mr. Darden, to show you how good my judgment is, on the day of the test I happened to be out on a trip with Mr. Davies, and——

Mr. DARDEN. In Las Vegas?

Dr. COOPER. No, at Wurtsmith Air Force Base, and Dr. Hicks said he thought there was a 35-percent chance for it to be a success. It can't be any better than 1 in a 100, I said.

It was a direct hit. It was a phenomenal success story for the first test.

### INTERCEPT TEST RESULTS

Date: 13 Sep 85.
Time: 20 42 46 Z.
Location: Over Western Test Range.
Target: Space Test Program [STP] P78-1.
Overall Assessment: Flawless.

General RANDOLPH. That is the test you are talking about there.

Dr. COOPER. Why are we restructuring the program? To be very candid with you, up until that point in time, the primary part of our effort was in demonstrating the capability of the ASAT.

We had a development program, a demo program, and then on the books we had a production program, but our efforts had been aimed at demonstrating the proof of concept that we could, in fact, through this system, shoot down a satellite.

After that occurred, Mr. Aldridge, Under Secretary of the Air Force, General Randolph and myself sat down and said, how do we get from here to there, going from development—which has now been demonstrated—to a paper program on production, and we did not have a good way of getting from the R&D program to the production program to produce equipment that was reliable, maintainable, and has a good shelf life.

And we commissioned a group to look at that, and they came in and said, the middle part of that program is missing, the transition from development to production. We are now putting effort into that area.

Mr. MCCURDY. What you are doing, one view of it might be that you have, at the end of this year, if you had those moneys, you will have perfected it to the extent prior to going into production—you have amateur system and production capabilities?

Dr. COOPER. A production worthy system, that is right.

Mr. MCCURDY. Some people say you may not be as confident as you were going into production, but you have done everything you can up to the stage where you actually open up an assembly line or whatever.

Dr. COOPER. It is time to start looking at that phase of the program. Now that we have demonstrated in a development sense that it will work, how do we get there from here?

Mr. MCCURDY. I don't think you will get the production moneys. I am saying where we are now is that you have gotten to the point that there is a little question in your mind that if you went into production, that you would have a workable system. Is that an accurate statement?

General RANDOLPH. Yes, sir.

Mr. **Battista**. Do you really want to go into production with this? You know you could do it. You can put the drawings aside. It was a good experiment, but isn't there a better way to do the mission with today's technology?

And I realize the argument, the proverbial better carrot, but there is a lot more expedient way to do it?

Dr. **Cooper**. We don't think it is in the near term. We think it is important to go forward. I think to talk about that further, we better go into a closed session.

Mr. **Darden**. All right. If there are no further questions from the members, we will recess in open session until 2 o'clock this afternoon.

The members will meet at 1:45.

[The Air Force acquisition statement FY 1987 follows:]

DEPARTMENT OF DEFENSE

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON, D.C.

MEMBERS OF CONGRESS

Over the past few years, we in the Air Force, with your support, have been able to make significant improvements in our forces. As a result, these forces are now better equipped, more capable, and at their highest peacetime readiness levels than at any time over the past decade. Our Fiscal Year 1987 budget supports these improvements. Moreover, our improved acquisition process will ensure that we make the best possible use of public funds we now request.

Though economic influences on our budget may change from time-to-time, the threat does not. The Soviets continue their unrelenting military growth, and the potential for low-level conflict which may involve the United States steadily increases. This is clearly not the time to reduce the momentum of our force modernization.

Air Force priorities--strategic force modernization; improved readiness and sustainability of our general purpose forces; increased airlift capability and modernized and expanded tactical forces; and improved capabilities in space--are formulated to best support our national military strategy. This budget is a well-balanced approach to achieving required growth in each of these areas.

We support our national commitment to a balanced federal budget. Our greatest contribution to this goal will be a careful stewardship of the resources entrusted to us. We have reduced the number of programs we manage, we have made great progress in increasing competition in our acquisition programs, and are actively pursuing other cost reduction measures. Further, we are aggressively participating in joint service acquisition programs and actively seeking cooperation with our NATO and other allies to reduce costly duplication of effort. In sum, we are working hard to do more with less.

We look forward to discussing our programs with you and request your support of our Fiscal Year 1987 budget.

Thomas E. Cooper
THOMAS E. COOPER
Assistant Secretary of the Air Force
Research, Development and Logistics

BERNARD P. RANDOLPH, Lt Gen, USAF
Deputy Chief of Staff,
Research, Development and Acquisition

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DEPARTMENT OF THE AIR FORCE

# EXECUTIVE SUMMARY

The U.S. Armed Forces protect and preserve the United States as a free nation. U.S. forces help assure the physical security of the United States as a democracy and protect U.S. interests abroad. The basic military strategy of the United States is the deterrence of war by making a potential aggressor unwilling to take the risk of starting a conflict. The security interests of the United States and its allies continue to be challenged by the sustained growth and improved performance of Soviet military forces, Eastern bloc, and surrogate exploitation of regional conflicts, and instabilities in many areas of the world.

The Soviets continue to increase and modernize their nuclear and conventional forces as well as their capabilities for projecting military power. Together with surrogates, they are attempting to weaken the ties between the United States and its allies and extend their influence in the Third World. Soviet military interventions further impede the peaceful resolution of Third World problems and contribute to regional instability by promoting wider conflict.

U.S. military strategy seeks to deter attacks against the United States and its allies, limit Soviet opportunities for coercion, and provide the flexibility to respond appropriately to aggression and terrorism . Therefore, U.S. forces must be capable of operating effectively throughout a spectrum extending from low-intensity conflict to strategic nuclear war. Readiness, sustainability, modernization, and a sound force structure are imperatives of the U. S. military posture.

Through the President's commitment to long-term defense modernization, our forces have reached a higher peacetime level of effectiveness than at any other time. When the President first came into office, he was faced with ten previous years of U.S. military decline while the threat was continually increasing. During the past five years, real growth in our military investment accounts (procurement, research, development, test and evaluation, and military construction) has resulted in the modernization of our equipment and a simultaneous increase in our readiness and sustainability for support of larger forces in the U.S and overseas.

Because of the steady rebuilding of our military capability, our strategic forces have become more capable and survivable; our tactical aircraft mission capable rates and wartime fighter sortie generation capability have drastically improved;our strategic airlift fleet has increased; and our command, control and communications have become faster and more survivable. All of these improvements to our force structure enable the U.S. military to better carry out the national security policy of protecting and defending American interests throughout the world.

The Fiscal Year 1987 investment in research, development, test and evaluation, procurement and military construction provides the future force structure capability to meet our national security objectives. The Fiscal Year 1987 investment programs account for 56% of the entire AF budget request. We feel this mix represents the most reasonable balance between operating our forces at a high level of readiness and investing in the development of future weapon system capabilities.

## EXECUTIVE SUMMARY

Our qualitative edge over the Soviets has been narrowing due to the large Soviet expenditures in science and technology and an intense program to acquire our latest weapons technology. Given our strategy to counter the large quantities of Soviet weapons with our technologically superior weapons, we must continue and increase a broad-based scientific and technology program across all mission areas. We cannot wait until the Soviets further close the technology gap because of the long lead-time required to field weapon systems utilizing new technologies. Further, we must shorten the development cycle for technologies which promise a high payoff in countering the projected threat.

To transition our science and technology efforts into development and production, we require a sound industrial base that can operate in both peace and wartime. Today's industrial base for producing defense equipment consists of privately-owned and government-owned facilities. The Air Force's Industrial Base Program analyzes current industry capabilities in light of acquisition programs and develops goals that tie industrial productivity enhancements to wartime responsiveness.

We must also improve readiness and sustainability despite increased weapon system performance and complexity. Our aircraft have to be able to deploy quickly to austere bases, and sustain high combat sortie rates. To accomplish these demanding requirements, the Air Force's Reliability and Maintainability (R&M) 2000 program is designed to accelerate R&M efforts in both fielded and new weapon systems. The two research and development programs that offer high payoffs are the R&M Maturation and Technology Insertion Program, and the Productivity, Reliability, Availability, Maintainability Program.

To develop a large array of sophisticated yet reliable and maintainable weapon systems within a period of austere resources, we must continue our efforts to improve our stewardship of the defense dollars allotted to us. We have instituted several acquisition management enhancement programs that are intended to reduce the cost of weapon systems, improve the spare parts acquisition cycle, create a top notch professional acquisition staff, and encourage a greater cooperation with our NATO partners in developing and acquiring weapon systems. Through these and other programs, we feel we can better manage the limited funds available for Air Force programs.

Our development programs and production lines can lead to improved war-fighting capability only if our forces are trained and ready to use this modern equipment, our peacetime stocks can support day-to-day operations and training, and we have the necessary repair facilities, spare parts, and consumables to sustain our combat forces. To improve our aircrew training, we have a full array of aircraft simulators that complement actual flight time, enhance combat capability, and improve safety. Results of recent aircrew combat competitions show that our pilot wartime proficiencies have reached their highest peacetime levels in years. Our readiness has also improved with the increased emphasis placed on our peacetime spares procurement. We have kept up our commitment to funding both the initial spares needed to support new weapon systems and the replenishment spares necessary to support operations and training programs. While revised fiscal guidance has impacted our war reserve stock procurements, we are still able to fund all new wartime kit authorizations for our fighting units.

## EXECUTIVE SUMMARY

The fundamental objective of U. S. nuclear forces is to remove all incentives for direct attack against the United States and its allies by promising any attacker a devastating outcome. The Soviet Union has continued to challenge the U.S. guarantee of effective retaliation and has threatened U.S. deterrent capabilities by strengthening certain measures of Soviet nuclear strength. To counter growing Soviet nuclear war-fighting potential, the United States gives high priority to the modernization of its nuclear forces and the study of means for defending against ballistic missile attack. Equitable and verifiable arms reduction agreements are being pursued in parallel with modernization programs. The goal of the United States is a more stable nuclear balance at lower levels of armament.

The United States' strategic nuclear forces are composed of sea-launched ballistic missiles, land-based ICBMs, and manned bombers. These forces, known as the Triad, represent our nation's resolve to deter any potential aggressor. The structure of the Triad discourages a first strike against the United States by complicating Soviet efforts to defend against this retaliatory mix of forces.

The ability to deter aggression exists only if we have the actual capability and will to retaliate. Since the Air Force is responsible for maintaining two-thirds of the Triad, the land-based ICBMs and the manned bomber, we have continued to seek modernization in both of these areas. We are modernizing our ICBM force through the upgrade of the Minuteman missile, the procurement of the Peacekeeper missile, development of a small mobile missile, and research on technologies to increase the survivability of our ICBM force. In addition, we have upgraded some of our B-52 systems to extend their lifetime and enhance their delivery capability. The B-52, through these improvements, provides an overlap until the Air Force's newest bomber, the B-1B, takes over the penetration role. To meet the expected advances in Soviet defenses, we are continuing the development of the Advanced Technology Bomber and both penetration and standoff missiles. With this new bomber and missile force mix, our bomber leg of the Triad will remain a credible deterrent to nuclear aggression well beyond the year 2000.

Strategic Defense encompasses detection of Soviet aircraft and missile attack, monitoring space activities, and defense against atmospheric and space-based threats to U.S. forces. These resources reduce the probability of a successful enemy's decapitating first strike attack, thus increasing stability between the United States and the Soviet Union.

Atmospheric surveillance and defense are responsible for the protection of North America against the air breathing threat. In Fiscal Year 1987, we will continue replacing the aging Distant Early Warning System with the new North Warning System to provide improved surveillance of the northern approaches. For coastal surveillance, we will continue procurement of the Over-the-Horizon Backscatter Radar. To ensure an effective interceptor force at lowest cost, the Air Force is holding a competition for approximately 300 new interceptors.

For space surveillance and defense, we are instituting several improvements to the SPACETRACK system, continuing space defense system tests, and improving space defense command, control and support programs.

Ballistic Missile Warning and Attacks Assessment is currently performed by a network of sensors. In Fiscal Year 1987, two new PAVE PAWS sites will be completed. These systems will provide coverage of the southeast and southwest sectors to complete 360 degree surveillance against Submarine-launched Ballistic Missiles. The Ballistic Missile Early Warning System will be upgraded by completing the replacement of 20-year old conventional radars at Thule Air Base, Greenland.

Finally, the Strategic Defense Initiative is exploring the potential of a system to counter ballistic missiles and their re-entry vehicles in flight. In Fiscal Year 1987, the Strategic Defense Initiative will continue funding five technology development areas: surveillance, acquisition, tracking and kill assessment; kinetic energy weapons; directed energy weapons; battle management/command, control, communications; and system analysis and supporting technology.

Without our Strategic Command, Control and Communication ($C^3$) systems, our strategic offensive and defensive weapon systems will not provide a credible deterrent against Soviet first strike. Our Strategic $C^3$ systems link our attack warning, defensive, and strategic retaliatory forces to command centers. They must be effective and reliable in the pre-, trans-, and post attack environment. Our current systems are being upgraded to become more survivable, and new systems are being produced and deployed to provide increased capability. In Fiscal Year 1987, the Air Force will continue development of the Milstar secure, jam-resistant communications system, the Ground Wave Emergency Network, the Minimum Essential Emergency Communications Network, and the Worldwide Military Command and Control Information System. We will continue production of Strategic Air Command Digital Network terminals and the Defense Satellite Communications System III satellites. Fiscal Year 1987 system upgrades will include the Aircraft Alerting Communications Electromagnetic Pulse Upgrade and the modifications to the EC-135 Post Attack Command and Control System and E-4B command post aircraft.

Space systems significantly increase the combat effectiveness of our strategic and conventional forces. The Soviets have recognized the importance of space in military operations and have made great strides in improving their space-based assets. We also have instituted programs to upgrade our space infrastructure of launch and on-orbit facilities, increase the survivability of our space systems, and improve the surveillance, communications, and navigation capabilities of our space systems. Infrastructure upgrades will include: upgrading the Titan 34D to launch shuttle-size satellites; upgrading the Titan II ICBM into a space launch vehicle for smaller satellites; upgrading the Satellite Control Facility data systems computers; and continuing the development and acquisition of the Advanced Remote Tracking Station. Improved performance and survivability of our space systems will be accomplished through: continued development of the Defense Meteorological Satellite and its ground command, control and communication network; continued procurement of improved Navstar Global Positioning System satellites and continued development and test of the Nuclear Detonation Detection System user terminals along with acquisition of the operational satellite segment.

Our theater forces still remain a key deterrent to aggression by the Soviet Union and her allies. The numerical advantage enjoyed by the Warsaw Pact has become even more ominous with the introduction of many Soviet technical advances in avionics, aerodynamics, and propulsion systems. To meet this ever increasing qualitative and quantitative threat, we are continuing our modernization programs in tactical aircraft; air-to-air missiles, air-to-ground munitions/missiles; battlefield management command, control, and communication ($C^3$) systems; defense suppression and electronic combat measures; theater nuclear capability; and chemical warfare protective systems and retaliatory weapons. We realize the importance of obtaining a balanced mix of offensive weapons, defense suppression weapons, $C^3$ and intelligence fusion information, and nuclear/chemical capability. The Fiscal Year 1987 budget request is designed to accomplish that mix without sacrificing the importance of readiness and sustainability.

Force projection is vital to our ability to deter aggression by displaying our readiness to use the correct force at the right time and the right place. Our three key elements of force projection are airlift, refueling, and special operations forces. Air Force airlift operates in conjunction with sealift and prepositioned war materials to provide the link between force structure and combat capability. With the final procurement of 21 C-5Bs in Fiscal Year 1987, we will have completed the major portion of our near-term airlift modernization that started in 1983. For our long-term requirements, we will complete full scale engineering development of the C-17 multirole airlifter in preparation for a 1988 production start. We will also begin the development and acquisition of two Air Force One replacement aircraft whose need was recognized by the last Congress. To complement our airlift leg of force projection, we have significantly increased our refueling aircraft fleet to support tactical as well as strategic readiness. In Fiscal Year 1987, we will complete our planned 60 KC-10 fleet with the purchase of eight aircraft and will continue the annual production of KC-135R re-engine kits to provide a 50% fuel availability increase to our primary strategic airlifters. To meet the threat of low level conflict, especially that posed by increased terrorist activity, we have started acquisition of additional MC-130H and AC-130H aircraft to supply airlift and accurate fire power in support of our special operations forces.

Supporting the development and production of our weapon systems requires extensive test and evaluation facilities. With the increased emphasis on testing, we plan to conduct several test range modernization and improvement efforts in Fiscal Year 1987.

Overall, this year's budget seeks to sustain positive growth in the future to meet our national security objectives and military strategy of deterrence and flexible response to hostilities. Through careful stewardship of public resources during the first five years of the Reagan administration, we have made significant improvements in force modernization, readiness, and sustainability. With improved acquisition techniques, we will continue to improve our military posture. We have developed a budget that strikes a prudent balance between research, development, test and evaluation, and procurement programs and takes into consideration competing military requirements and program priorities. Congressional approval of this Fiscal Year 1987 budget will allow us to sustain our past gains and meet the growing threat.

*LASER ENGINEER INSPECTING GAS DYNAMIC LASER AT KIRTLAND AFB, NEW MEXICO*

DEPARTMENT OF THE AIR FORCE
MCMXLVII
UNITED STATES OF AMERICA

# I. INVESTING IN THE FUTURE

## A. Maintaining The Military Balance

In developing this year's budget request, we struck a balance between maintaining our forces' readiness and modernizing our forces to meet an ever increasing threat. Within the current climate to reduce spending, we have adjusted our request to remain within established funding limitations. Despite these austerity measures, we believe the budget still preserves our current wartime capability while maintaining growth in our capability in the future.

In developing this year's research, development, procurement, and logistics budget request we continued to use the following priorities to establish a framework for making our decisions:

- modernize our strategic offensive and defensive forces,
- improve combat readiness and sustainability,
- increase airlift capability,
- modernize and expand our tactical and Air Reserve forces,

We are also improving our ability to operate efficiently and effectively in space. This nation's heavy civilian and military reliance on space-based systems, coupled with the Soviet's potential to disrupt our space systems, requires that we meet the opportunities and challenges space development presents.

## B. Fiscal Year 1987 Air Force Budget - Investment Accounts

This year's budget was developed to directly support our strategies for achieving national security objectives in the current and future world environment. Within the present world environment, the predominant threat to the U.S. and our allies national interests is the Soviet Union's military with its advances in technology, expansion of strategic and general forces, and its emerging ability to project military power across great distances. This increased capability has enabled the Soviets to directly and indirectly infringe upon the freedom of other nations. We must protect our freedom as well as that of our friends and allies through deterring direct attack and indirect coercion. Our military strategy is based on the deterrence of war. Should deterrence fail, our wartime strategy is to terminate conflict on terms favorable to the U.S. and its allies.

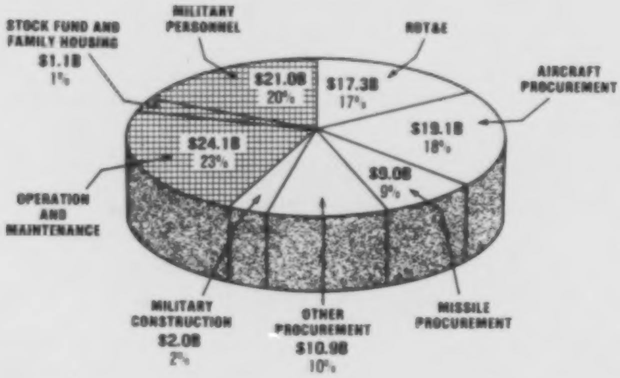
The Air Force's Fiscal Year 1987 budget request provides the balanced combat capability the nation requires to achieve U.S. national security objectives. At the same time, it also provides the proper balance between funding the investment in the developing our future capabilities, as well as maintaining our current readiness and sustainability.

## INVESTING IN THE FUTURE

The diagram below illustrates the breakdown among seven major appropriation categories of the Air Force Fiscal Year 1987 budget. The clear sectors comprise the investment accounts and the hatched sectors the operating accounts. Shown in each sector are the dollars requested for Fiscal Year 1987 and the associated percentage of the total request for each account.

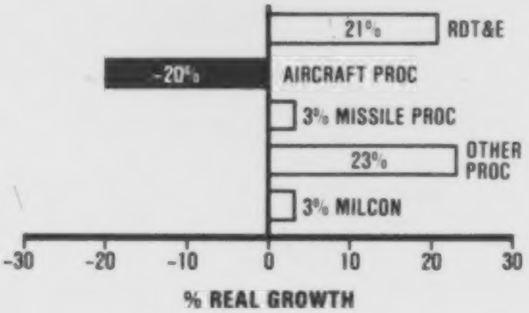
*AIR FORCE BUDGET REQUEST*
*1987*

**$104.5B**



Each investment appropriation's real growth rate as compared to the Fiscal Year 1986 Department of Defense (DoD) Appropriations Act is shown in the chart below. Overall, the Fiscal Year 1987 real growth rate remained almost constant compared to the Fiscal Year 1986 DoD Appropriations Act.

*AIR FORCE BUDGET GROWTH RATE*
*1987*



## INVESTING IN THE FUTURE

The Research, Development, Test and Evaluation (RDT&E) appropriation has increased 21% with the largest changes attributed to planned increases in development programs in the Tactical and Strategic areas. Tactical programs with the largest changes are C-17, Advanced Tactical Fighter and the Joint Surveillance and Target Attack Radar System. The strategic program increase is due to the Advanced Technology Bomber, AF Satellite Communications, Milstar, Short-Range Attack Missile II, and the Small Intercontinental Ballistic Missile and Hard Mobile Basing portion of ICBM Modernization.

Aircraft procurement has shown the sharpest decline (-20%), as a result of both previously planned program reductions, and new reductions, such as the HH-60 and T-46. Overall aircraft procurement quantities have increased from 333 aircraft in Fiscal Year 1986 to 359 aircraft in Fiscal Year 1987. The largest quantity changes result from the completion of the B-1B production, an F-16 increase (+36 aircraft) and the new procurement of 38 Civil Air Patrol aircraft. Shown below is a comparison of current U.S. and Soviet combat aircraft.

### *CURRENT U.S. AND SOVIET COMBAT AIRCRAFT**

| Category | U.S. Aircraft | USSR Aircraft |
|---|---|---|
| Air-to-Surface | B-52, B-1B | Backfire, Bear, Bison, Badger, Blinder |
| | F-111 | Fencer, Fitter |
| | F-4, A-7, F-16 | Flogger, Fishbed |
| | A-10 | Frogfoot |
| Air-to-Air | F-15, F-4 | Flogger, Foxbat, Foxhound, Fiddler, Flanker |
| | F-16 | Fulcrum, Fishbed, Flagon, Firebar |
| RECCE/EW/-AWACS | RF-4, SR-71, U-2, TR-1 | Fitter, Foxbat, Fishbed |
| | RC-135 | Bear, Blinder |
| | EF-111 | Fencer, Brewer, Badger |
| | E-3, EC-130 | Mainstay, Moss, Cub |

* Note: Aircraft used for Force Projection and Training are not included.

(As of 1 January 1986)

Missile Procurement shows a modest 3% growth due to several changes in both directions. While there where decreases in Peacekeeper, spares/repair parts and other support items, there were sizeable increases in our air-to-air and air-to-ground tactical missile procurements. Sparrow and Sidewinder procurements will continue to provide needed air-to-air capability while the Advanced Medium-Range Air-to-Air Missile production line becomes fully qualified. For air-to-ground missiles, the High Speed Anti-Radiation Missile missile has reached its peak production level while the Maverick and AGM-130 missiles are still ramping up to next year's steady production levels.

Other Procurement increased 23% this year. Within Munitions and Associated Equipment, the largest increases were due mainly to the CBU-87 combined Effects Munition, the GBU-15 and the 2000 lb. hard target bombs. Within Electronics/ Telecommunications, the most significant increases are in the PAVE

Submarine Launched Ballistic Missile Warning System, Range Improvements, Joint Tactical Communications, Satellite Control Facility, Consolidated Space Operations Center, Minimum Essential Emergency Communications and Base Level Data Automation. Within other Base Maintenance and Support Equipment, the Chemical/Biological Defense Program shows the most significant increase in the Research and Development related programs.

Summaries of Fiscal Year 1987 funding estimates for individual RDT&E and procurement programs are provided at Appendix A. More detailed information and program justification are provided to the Congress separately. This detailed justification information is contained in the Department of the Air Force Justification of Estimates for Fiscal Year 1987 for the procurement programs and in the Descriptive Summaries for Fiscal Year 1987 for the RDT&E programs. Information on military construction programs is also provided to the Authorization and Appropriation Committees of the Congress.

## C. Science and Technology

1. Soviet Challenge to the United States: The U.S. no longer enjoys the vast superiority in weapon system quality which, in the past, was the counterbalance to the significant Soviet advantage in weapon system quantity. The rapidly narrowing U.S. technology lead over the Soviets is primarily due to the science and technology budget level and the covert acquisition of advanced technologies by the Soviets. Given the assumption that the Soviets will continue to build their weapon systems in large quantities, the U.S. is faced with the option of achieving equality in weapon system numbers, or reestablishing unquestionable technological superiority. Since the U.S. has traditionally relied on its quality of weapons systems to offset quantity disparities, we must maintain a broad-based Science and Technology Program that addresses all assigned Air Force mission areas which have sufficient funding to selectively demonstrate high payoff advanced technologies.

2. Science and Technology Strategy: Our technically advanced weapon systems today are the result of carefully planned science and technology investments made several years ago. Because of the long lead time required from the time the science and technology investment is made until the time the demonstrated technology appears in a fielded weapon system, it is critical that sufficient funding is made available now to ensure an advanced technology lead in the next generation weapon systems. This lead-lag situation puts a tremendous burden on the long-range planners to identify future battlefield scenarios and weapon systems. Using the long-term scenario, the science and technology investment strategy has been developed to be responsive to the postulated threat and operational tactics.

While the Air Force must continue to develop broad-based technologies to support the core science and technology program, the investment strategy process must identify those technologies that are revolutionary and will significantly contribute to our warfighting capabilities. However, identification of revolutionary technologies is not enough. We must also have the resource flexibility to pursue those areas that will significantly impact our future weapon systems. Adequately funding the core program and pursuing high payoff technology initiatives will require additional resources allocated to the Air Force Science and Technology Program. The Air Force long-term plans, and in particular the Fiscal Year 1987 budget request, are designed to invigorate our Science and Technology Program to ensure that adequate resources are available for both broad-based mission support and high payoff technology initiatives.

3. High Payoff Technologies: Described below are a number of high payoff technologies that will significantly contribute to our future war fighting capability and our technological superiority over the Soviets.

a. Advanced Microelectronics: Microelectronic advancements such as in Very High Speed Integrated Circuits (VHSIC) and gallium arsenside (GaAs) circuits will result in significant weight and size savings, enhanced reliability and maintainability, and orders of magnitude increases in performance. Both VHSIC and GaAs are expected to be pervasive in future Air Force weapon systems.

b. Advanced Materials: Advanced metallics and composites will extend operating envelopes of advanced aerospace vehicles and enhance survivability, reduce system weight, and provide design flexibility not presently available with existing materials. Metal-matrix composites, for example, will significantly contribute to our ability to build large space structures.

c. Advanced Avionics Architectures: Advanced avionics architectures will allow the integration of many subsystem functions handled individually in today's systems. Weapons delivery, engine management, cockpit controls/displays, flight controls, communications, and navigation are examples of functions which might be integrated. This integration would allow, among other things, higher mission reliability and reduced aircrew workload.

d. Sensor Fused Integration: As the microelectronic technologies mature we will have the processing capability to centrally process very large quantities of information gathered from multiple sensors. This sensor fusion will be a significant contributor to survivability by exploiting large amounts of real-time target information without overloading the pilot and will be one of the subsystems integrated in the advanced avionics architecture.

e. Directed Energy: We are developing advanced directed energy weapon technologies such as phased array telescopes and coupled energy devices that will augment existing conventional weapon systems. Directed energy devices will fully complement conventional weapons and will additionally provide advanced imaging capabilities using unique capabilities provided by advanced directed energy technologies.

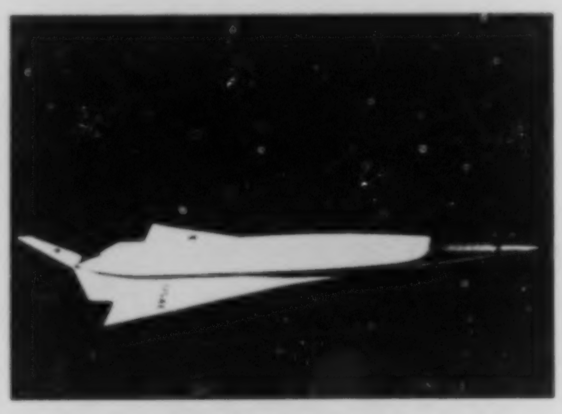
f. Software: As the Air Force weapon systems evolve into those that include a number of embedded computers and advanced architectures, it will be increasingly important to develop advanced software technologies that are user friendly and are robust enough for all applications. Use of the Ada language and efforts of the Software Engineering Institute (SEI) will provide the software technology required for future weapon systems.

g. Artificial Intelligence: We expect artificial intelligence technology to be applied to great advantage in aiding decisionmaking in future fast paced combat scenarios. Artificial intelligence will enable us to automate some functions now accomplished manually in command and control systems, such as targeting and mission planning. The commander's job will be made easier through the analytical power and speed of the artificial intelligence systems he can use to aid force employment/disposition decisions in complex battle scenarios.

h. **Advanced Aerodynamics**: The Advanced Fighter Technology Integration/F-16 (AFTI/F-16) and the X-29 program are flight test vehicles that demonstrate in the aerospace environment advanced flight technologies such as voice interactive systems, terrain following-terrain avoidance, forward swept wings, aeroelastically tailored wings, and advanced composites. Advanced aerospace technologies will significantly contribute to our basic understanding of transatmospheric flight and atmospheric supersonic sustained flight.

i. **Man/Machine Interface**: Finally we must not forget that Air Force operations will continue to be dominated by man. In all future weapon system developments we must consider man's limitations and ensure that system design evolution includes advanced technologies that complement and extend rather than duplicate human skills.

4. **National Aerospace Plane**: The National Aerospace Plane (NASP) Program is a research program intended to demonstrate a vehicle which can operate as an airplane at hypersonic speeds or as a space vehicle with the capability of accelerating directly (single stage) into orbit. It is envisioned to be a hydrogen fueled, horizontal takeoff and landing vehicle capable of operating from standard runways worldwide. The NASP will have major operational utility for both military and civil/commercial applications. One of its major payoffs will be to provide the technology bases to allow flexible and responsive systems that will satisfy both civic and military space transportation needs at reduced cost.



***NATIONAL AEROSPACE PLANE***
*Conceptual Model*

The NASP program capitalizes on past hypersonic research conducted by the Services, DARPA and NASA and focuses research for the purpose of demonstrating a hypersonic research or X-vehicle. Program studies began in 1982 and continued through 1985 (Phase I) under the DARPA program Copper Canyon.

The NASP program is initiated with Phase II, Technology Development and Application Studies. Phase II will enhance the necessary technologies to build actual engine modules and design a vehicle capable of operating in the desired regimes. Based on the results of the Phase II technology evaluation, a decision will be made on whether to fabricate and flight demonstrate a follow-on experimental flight vehicle (Phase III).

5. Summary: There are a number of advanced technologies that will maintain our technological superiority and significantly contribute to our future war-fighting capability. However, we must maintain a balance within the Science and Technology Program between development of revolutionary and evolutionary technologies. And finally, we are cognizant of the need also to maintain the proper program balance between performance enhancement and system supportability and affordability.

## D. Reliability and Maintainability 2000

1. The Concept: The Air Force Reliability and Maintainability (R&M 2000) Program was developed by direction of the secretary of the Air Force and chief of staff of the Air Force to institutionalize the Air Force's commitment to improving reliability and maintainability of weapon systems. Reliability and maintainability must be coequal with cost, schedule, and performance factors as the Air Force brings new systems into the inventory and modifies its existing systems.

The Air Force requires improved reliability and maintainability of both new and fielded weapon systems. To achieve this, the Air Force is stepping up its search for basic system changes that will ensure the most reliable, maintainable systems possible for the dollar invested. Reliability and maintainability are means to an end, and that end is combat capability. Reliable systems reduce the ownership costs of systems, reduce the system's dependence on spare parts, require fewer combat support people and result in more missions per deployed system.

2. The Objectives: The objectives of the R&M 2000 program are to:

- Provide clear direction aimed at increasing reliability and maintainability of Air Force systems to increase weapon system combat effectiveness.

- Focus organizational attention and expand training to build the reliability and maintainability technical expertise, advocacy, authority and accountability throughout the Air Force.

- Improve reliability and maintainability planning to consolidate efforts, tie reliability and maintainability to operational goals, and coordinate major command efforts to accelerate improvements in weapon system reliability and maintainability.

- Establish internal administrative systems in order to ensure effective accountability and feedback to measure progress in the reliability and maintainability improvement program.

- Provide positive communications and motivation to sustain commitment to and support for reliability and maintainability goals.

- Obtain and sustain industry commitment to ensure that contractors have the motivation and capability to support reliability and maintainability requirements.

3. The Goals: The Air Force has set five goals to achieve the objectives of the R&M 2000 plan. The achievement of these goals requires institutional commitment to reliability and maintainability in the Air Force weapon systems. These goals are:

a. Increase Warfighting Capability: The U.S. Air Force will measure increased warfighting capability for each of its many different kinds of weapon systems. For aircraft warfighting capability, for example, improvements are expected in the number of consecutive missions a system is capable of flying in combat without requiring maintenance other than refueling and reloading ordinance. The future advanced tactical fighter of the 1990s will be designed to operate at a sustained sortie rate at least twice that of the F-15 Eagle.

b. Increase Survivability of the Combat Support Structure: Many current Air Force systems are dependent on large combat support facilities which are vulnerable to attack and destruction under combat conditions. The key to increased survivability is to reduce dependence on vulnerable fixed operating bases. One way to do this is to make use of technological advances that will reduce dependence on complex maintenance facilities such as the avionics intermediate shop needed to support such systems as the F-15 and F-16. Reducing the need for sophisticated and complex test equipment like the avionics intermediate ship means that fewer combat support people and highly trained maintenance specialists would be placed "in harms way" during a conflict.

c. Decrease Mobility Requirements Per Deploying Unit: Through reliability and maintainability improvements, such as Air Force fighter aircraft with built-in test and on-board fault detection and isolation systems, fewer maintenance people and less support equipment would be needed in a combat zone. Presently more than five C-141B Starlifters are needed to airlift an avionics intermediate shop for a deploying squadron of F-15s. It now takes about 18 C-141B aircraft loads (equivalent) to deploy an F-15 squadron.

By reducing dependence on an avionics intermediate shop through improvements in the avionics system, the Air Force could deploy four squadrons of F-15s with the same airlift required to deploy three squadrons today.

d. Decrease Manpower Requirements Per Unit of Output: Gains in reliability and maintainability translate directly into increased productivity for the highly trained, highly skilled technicians needed to maintain today's aerospace systems. Air Force people are a constrained resource which must be considered during the earliest design stages of weapon systems. Reliability and maintainability improvements will provide the Air Force with the opportunity to reduce dependence on combat support people in future systems, and the potential to reallocate already constrained people resources into priority Air Force activities.

e. Decrease Costs: The decrease in costs through improved reliability and maintainability would come from savings in areas such as acquisition costs, operating and support costs, manpower, training and spare parts costs. For example, the Air Force manages approximately 890,000 different types of spare parts. The parts inventory is worth more than $38 billion. In Fiscal Year 1985, the budget contained more than $6 billion for spares. Management of spare parts involves a highly complex system that employs hundreds of thousands of people. Consequently the higher the reliability of Air Force systems, the smaller the requirement for spare parts and the greater potential for savings.

4. The Programs: Two research and development programs that implement the R&M 2000 goals are: (a) the R&M Maturation and Technology Insertion Program; and (b) Productivity, Reliability, Availabiliy, Maintainability (PRAM) Program.

The R&M Maturation and Technology Insertion program takes a two-pronged approach in attacking the Air Force's more pressing R&M needs. First, we intend to fund selected high leverage generic R&M maturation and technology programs for insertion into current weapon systems. The second effort provides a vehicle to accelerate and apply emerging technologies to developing/future weapon systems. The thrust of this latter initiative is to reduce the cost, schedule, and technical risk.

The three largest projects within the R&M Maturation and Technology Insertion Program are On-Board Inert Gas Generating System (OBIGGS), Molecular Sieve Oxygen Generating System (MSOGS), and radar maturation for the F-15 and F-16. The C-17 OBIGGS effort to improve prevention of fuel tank fires, improve maintainability, and reduce life cycle costs is well underway. In Fiscal Year 1987, prototype fabrication will be completed and qualification testing will be performed to support a production decision. In addition, work will begin to incorporate OBIGGS into the C-130. In terms of MSOGS, studies and operational experience indicate that MSOGS provides significant improvement over the current liquid oxygen (LOX) system. These improvements include: higher reliability - by a factor of 10; greater survivability - LOX infrastructure not required; decreased mobility requirements - 3 to 5 fewer C-141 pallet equivalents per deploying squadron; decreased manpower requirements (per wing) and; lower life cycle costs. Our objective is to incorporate MSOGS into the F-15E as soon as practical. Finally, the radar maturation project will provide funding to transition selected F-15/F-16 radar improvements into R&M modifications and enhance the radar manufacturing process. In Fiscal Year 1987, we intend to start work on developing an improved built-in-test capability for the APG-63 radar and applying a more stringent Environmental Stress Screening (ESS) to the manufacture of the APG-70 radar for the F-15 aircraft.

The second research and development program, PRAM, provides a means to immediately respond to identified weapon system problems through judicious and timely investments in projects leading to improved combat effectiveness and lower life cycle costs. PRAM projects fall under the areas of airframes, avionics, propulsion, missiles, space, depot maintenance, and other support areas. Since its inception, PRAM has initiated 780 projects with an estimated savings to the Air Force of $3.1 billion. This equates to a $5 net return for every dollar invested in the PRAM development and modification. The following are examples of the types of projects PRAM works:

Extended Life Turbine Wheel. The product of this effort was the development of new materials for the turbine wheels of the F-16 Jet Fuel Starter (JFS) and the KC-135R Quick Start Auxiliary Power Unit (APU) System (QSAS). This new material will extend the service life of the F-16 JFS from 500 starts to a minimum of 2000 starts and the K-135 QSAS from 1000 hours to over 2600 hours. Development and implementation cost $1.1 million. Estimated 5 year savings is $30 million.

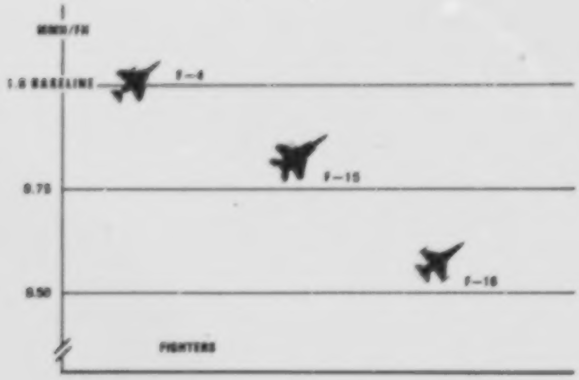
F-15 Honeycomb Structure Replacement for Stabilators and Wing Tip. Project resolves corrosion, cracking and delamination problems on F-15 stabilator leading and trailing edges and wing tips by replacing existing honeycomb structure with superplastically formed bonded titanium/aluminum. Replacement will provide a two-fold improvement in reliability. Development and implementation cost $3.5 million. Estimated 5 year savings is $18.3 million.

B-52/C-130 Autopilot. PRAM has designed a state-of-the-art digital Line Replaceable Unit (LRU) to replace the three highest failure components of the B-52 and C-130 autopilots. Incorporation will provide a 10 fold improvement (25 to over 250 hours Mean Time Between Failure (MTBF)) in B-52 autopilot reliability and a doubling (200 to 500 hours MTBF) in the C-130. Development and implementation cost $11 million. Estimated 5 year savings is $119 million.

The enthusiastic response to R&M 2000 has generated substantial growth in the proposed PRAM projects from the Air Logistics Centers and Major Commands. Currently, PRAM is in the process of reviewing 108 potential projects which require $63.3 million in funding. These projects cover a wide spectrum of Weapon System R&M problems from development of an automated Technical Order System to improvements in F-15 electronics. Unfortunately, the Fiscal Year 1986 funding is insufficient to meet the demand. Accordingly, PRAM has had to defer many projects until Fiscal Year 1987. Without question, the PRAM program is an Air Force success story. The higher level of funding requested for Fiscal Year 1987 is consistent with and reflects the increased demand for improved R&M in our weapon systems.

5. The Accomplishments: Significant improvements to Air Force weapon systems have been made in recent years. R&M 2000 will increase the pace of those improvements. Current systems are more reliable and maintainable than the systems they replaced. For example, the F-15 requires only 85 percent of the maintenance manhours per flying hour than the older F-4 Phantom aircraft. The F-16 requires only one-half the maintenance man-hours per flying hour as the F-4. The Air Force expects the Advanced Tactical Fighter maintenance goals to meet or exceed current fighter maintenance levels, and for cargo aircraft, the Air Force expects the C-17 to require less than one-half the maintenance man-hours per flying hour of the C-5A Galaxy. The maintenance man-hours per flying hour are significant factors since, of the more than 485,000 enlisted people in the Air Force today, one in every three is involved in maintaining aircraft.

While these improvements are noteworthy, the challenges we now face are becoming more numerous and severe. The growing Soviet threat has made operating bases and the systems, people, and support equipment located there increasingly vulnerable. Successful operations in this environment demand increased war-fighting capability, survivability, and mobility. In addition, manpower availability will decrease over the coming decade making it more difficult to recruit and train the technical personnel needed to maintain increasingly complex weapons. Finally, current budget realities demand lower operations and support costs.



*MAINTENANCE MAN-HOURS PER FLYING HOUR COMPARISON*

6. Summary: The Air Force R&M 2000 goals provide the key leverage points for achieving increased combat capability; increased survivability of the combat support structure; decreased mobility requirements per deploying unit; decreased manpower requirements per unit of output; and decreased costs. Revising the way the Air Force views reliability and maintainability will not be enough. Reliability and maintainability are now coequal with the cost, schedule and performance factors associated with the acquisition of new systems and modifications to existing systems.

The payoff from these and other improvements in reliability and maintainability will be enhanced combat capability and an improved deterrent posture for America's "Arsenal of Democracy".

## E. Industrial Base

The United States' defense-related industrial base consists of privately-owned and government-owned industrial facilities needed to produce and maintain military items required by the Armed Forces in peace and wartime. The industrial base is a major element of national defense. A healthy base is of tremendous value as a deterrent to aggression.

The Air Force Industrial Base Program (IBP) mission is to direct industrial base activities as tasked in Executive, Congressional, and Department of Defense guidance. The Air Force program ensures the goals of productivity, efficiency, and cost-effectiveness that are normally associated with peacetime acquisition complement industrial preparedness and those actions that are necessary to accelerate production in times of national emergencies.

## INVESTING IN THE FUTURE

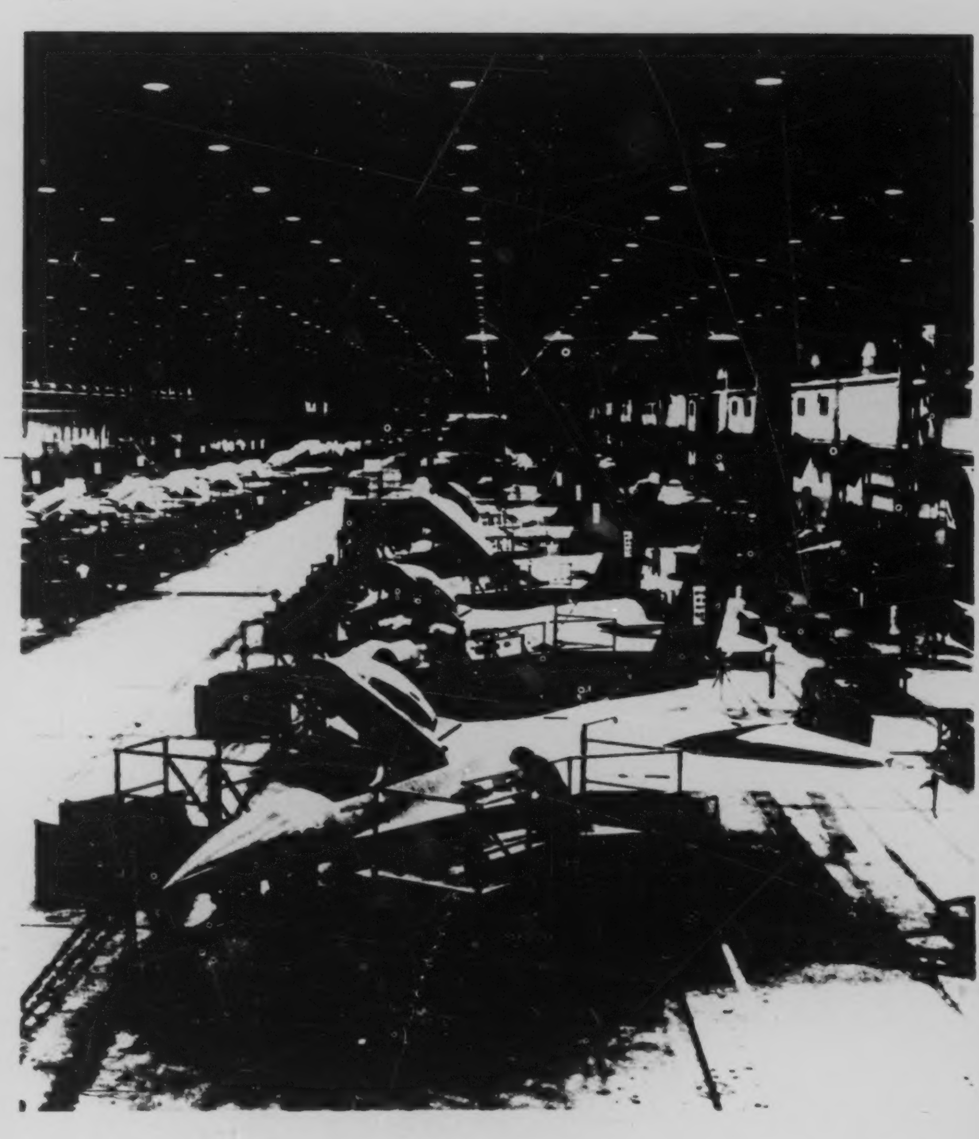
Air Force IBP planning ties together many elements that impact industry and industrial responsiveness. The Air Force goal is to deal with industrial base issues cohesively. Industrial responsiveness actions must complement productivity efforts and be part of the normal acquisition process. The key to Air Force industrial base plans is not the invention of new programs to deal with deficiencies, but to use the current acquisition system with greater effectiveness.

Air Force objectives in this area focus on a revamped, annual Production Base Analysis (PBA) methodology. The PBA process is not unique. It is based on approaches that have been around for many years. The PBA uses analyses gathered from a vertical look at weapon systems and from a horizontal look that cuts across industry and Service lines to view entire industry sectors. The PBA then ties findings and industry deficiencies to recommendations for action. For example, it might recommend adjustments to the Government Plant/Facility Plan or call for initiating a Manufacturing Technology or Industrial Modernization Incentives Program. It may require a more traditional preparedness action like stockpiling, the purchase of special test equipment, increases in war reserve stock kits, or in funding rolling inventories.

Many of the IBP activities are monitored through a single Air Force Program Element, 78011F. This element includes Industrial Base Program Planning, Government Plants, Production Surge, Manufacturing Technology and Technology Modernization program funding. Other IBP activities are funded as part of the individual weapon system or Air Logistic Center program plans.

The Air Force looks at the current IBP with a great sense of accomplishment. In the late 1970's, the Air Force had virtually no IBP because of the prevalent view that wars would be short. Because the industrial base may take a long time to accelerate deliveries, it was not considered a factor in war planning. The complications and magnitude of the task to understand the industrial base were staggering; therefore, few efforts were made to use the industrial base as a valuable part of overall deterrent strategy. Renewed emphasis in the 1980's on sustainability and improved methodologies for incrementally characterizing the industrial base, sector by sector, now allows the Air Force to accurately understand the base and actually work within the normal acquisition system to influence improvements and modernization of the defense industrial base.

***ELECTRICAL ENGINEER WORKING ON INTEGRATED CIRCUIT DESIGN WRIGHT-PATTERSON AFB, OHIO***



*GENERAL DYNAMICS F-16s BEING MANUFACTURED AT FORT WORTH, TEXAS*

# II. ACQUISITION MANAGEMENT ENHANCEMENTS

## A. Objectives

The Fiscal Year 1987 budget was developed in an environment in which a broad range of new acquisition management policies and practices had been established. The success of the Air Force research, development and acquisition program depends on a strong, efficient management system. Within the past year the basic process through which we acquire and support complex weapon systems has been subjected to meticulous evaluation and numerous management techniques have been refined to ensure better control of our resources. In conjunction with this budget submission, a broad range of improvements will be pursued in basic acquisition policy, spare parts acquisition systems, people programs, and NATO Cooperation.

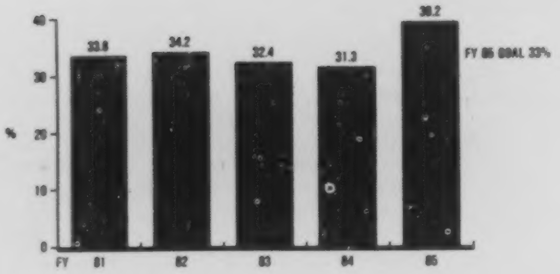
## B. Acquisition Policy and Procedures

1. Acquisition Cost Reduction: The management initiatives discussed in the following paragraphs of this section are being instituted to reduce the costs of weapon systems. At the top of our list is increasing competition across the board in Air Force contracting.

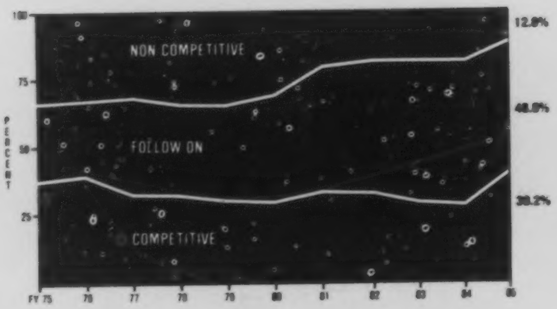
2. Competition Advocate: The Air Force believes that increasing competition is the most important initiative we can pursue to reduce the cost of all acquisitions, from major weapon systems to spare parts. In January 1982, we established the Competition Advocate Program. In addition, the commanders of 15 major commands and operating agencies have established three-year competition plans designed to reach the goals established. We have sent to the field more than 300 Competition Advocates to serve in more than 160 contracting locations throughout the Air Force. Our advocacy efforts have been made institutional through published directives that map out program infrastructure. In response to Congressional direction the Air Force Competition Advocate General office was established three years ago to further increase our emphasis on competition. The advocate, a general officer, is on the staff of and reports to the Assistant Secretary of the Air Force for Research, Development and Logistics. This office is reviewing all justifications for proposed noncompetitive awards exceeding $10 million and recommends disposition to the Assistant Secretary. In light of these efforts, our Fiscal Year 1985 accomplishment was 39.2% of our procurement obligations. An additional 48% was awarded as follow-on to procurements that were originally competed. Non-competitive acquisitions were only 12.8%, the lowest in over ten years. We have established an Air Force competition goal for Fiscal Year 1986 of 42% of our procurement obligations. (The Fiscal Year 1987 goal will be developed during 1986). This is a 9% increase over our Fiscal Year 1985 goal of 33%. We have given emphasis to proven techniques such as second sourcing, component breakout, and subcontract competition. These techniques serve to mandate the use of competition throughout the acquisition cycle.

## ACQUISITION MANAGEMENT ENHANCEMENTS

### *AIR FORCE COMPETITION PERFORMANCE*



***PERCENTAGE OF CONTRACT DOLLARS AWARDED COMPETITIVELY***



***AIR FORCE PROCUREMENT***
***DOLLARS COMPETED***

a. **Second Sourcing**: Second sources are being used in a number of major programs at the prime contract level. These include production contracts involving the Alternate Fighter Engine; the AIM-7M and AIM-9M air-to-air missiles; the imaging infrared Maverick air-to-ground missile; the Ground Launched Cruise Missiles and the combined effect munition. We are introducing a second source for the Advanced Medium Range Air-to-Air Missile. We are also initiating a competition between the F-16, F-20, and other appropriate aircraft for the Air Defense mission.

## ACQUISITION MANAGEMENT ENHANCEMENTS

b. Component Breakout: Below the prime contractor level, the Air Force is actively working to save contract dollars. By breaking out components from prime contractors for competition, we save overhead and handling costs. A variety of subsystems and components now are being pursued. These include canopy transparencies, wheels and brakes for the F-16 and B-1B, B-1B InertialNavigation System, radomes, and vertical situation display/gyro stabilizer; F-15 countermeasures dispenser, and the F-16 radar.

c. Subcontract Competition: Competition by our prime contractors with their vendors and suppliers also is being actively encouraged. Subcontract competition plans are required for major programs to ensure that the prime contractors consider competition in their buy decisions. While subtier competition is not recognized in Air Force competition statistics, it produces all the benefits of competition for our weapon system programs. The Air Force has proposed a change to the Federal Acquisition Regulation for subcontract competition reporting to help improve subcontract competition.

3. Acquisition Streamlining: The Air Force believes overspecification can be a significant cost driver on our weapons acquisition programs. To improve this and other aspects of the acquisition process, the Air Force is an active participant in OSD's Acquisition Streamlining Initiative. For example, in January 1985 we appointed a Streamline Advocate. This position was established to focus overspecification policy development, systematically review the acquisition process, and to institute methods and initiatives which will reduce the time and cost of weapon systems acquisition while maintaining or improving product quality. With the initial focus on overspecification, the Air Force, in September 1985, published a change to our overall acquisition policy regulation. In addition, the Streamline Advocate has been included in the initial review of operational requirements to ensure these are not overstated. Further, overspecification of replenishment items is a basic consideration of our Zero Overpricing Program. Finally, we have actively supported internal and OSD initiatives and policy development to prevent overspecification, reduce contract requirements and improve the acquisition process.

4. Program Stability: To be efficient, the acquisition process must operate in an environment that has stable requirements, financial resources, and managerial support. Unless stability exists, the acquisition process will be continually faced with uneconomical program stretchouts, cost overruns, technology updates, and management inefficiencies. The Fiscal Year 1987 program includes employment of proven management techniques that encourage this vital stability in programs.

a. Program Baselines: After careful review, we select those major acquisition programs for HQ/AF approval which will benefit the most from enhanced program stability. This baseline is an agreement between the developer, usually Air Force Systems Command, the users, TAC, MAC, SAC, etc., and the supporter, usually Air Force Logistics Command, that the requirement, direction, funding, and schedule will allow us to field a system when it is needed, at a realistic cost, with proper logistics support and, and most important, with the capability required. Signed by senior Air Force leaders, the baseline document highlights those programs which are felt to be most important to fulfill our national objectives. Baseline agreements are maintained throughout the acquisition program and have proven to be a valuable aid in controlling cost growth on systems such as the B-1B, KC-10, F-15, F-16, Ground Launched Cruise Missile, and Defense Meterlogical Satelite Program. The Ground Wave Emergency Network program will be baselined in Fiscal Year 1987.

b. Multiyear Procurement: Since the multiyear law was expanded in 1982, the Air Force has initiated thirteen major efforts involving multiyear contracting techniques. The savings from these contracts exceed $3.2 billion. In addition, the agreements have resulted in programs that have been free from major quantity changes that might have otherwise occurred during the multiyear contract term. This stability might not have been possible without the detailed process used to select our existing and proposed multiyear contracts. They include B-1B aircraft production and spare parts, the Navstar Global Positioning system satellites the KC-10 tanker cargo aircraft and the Defense Satellite Communication System III satellite. The F-16 aircraft began its second multiyear procurement contract in Fiscal Year 1986.

5. Should Cost: Should Cost reviews are being conducted of our major contractors to ensure that engineering labor, manufacturing effort, and overhead resources are being used as efficiently as possible. The Government evaluation team, consisting of engineers, auditors, and pricing specialists, reviews all areas of cost and prepares an overall evaluation. The recommendations will be used in the formulation of price objectives and during negotiations. Should Cost team members will participate in negotiations and assist the contracting officer in realizing the recommended savings. Should Cost analyses have yielded significant cost savings in the past. To aid in evaluating other programs, documentation will become part of a history that will be available for use by other Should Cost teams faced with similar program efforts.

6. Work Measurement: Program managers have incorporated the requirements of MIL-STD-1567A, "Work Measurement," into their contracts to obtain direct labor productivity information for use as a baseline in estimating manufacturing costs. Programs for which it is proposed that Work Measurement not be used must first obtain a waiver approved by the Secretariat. Air Force Systems Command (AFSC) reviews contractors' systems for establishing engineering work standards in compliance with MIL-STD-1567A, and reports to the Secretariat on all instances where tailoring of the MIL-STD-1567A has been approved. The use of MIL-STD-1567A is a key to determining contractors' productivity. Productivity indicators are now included in all program assessments. AFSC has issued policy that requires the use of engineering work standards in estimating and negotiating contract costs. The Fiscal Year 1986 Department of Defense Authorization Act specifies Work Measurement as the preferred method for establishing the direct labor hour standards and tracking system associated with the contractor Bills of Labor.

## C. Spare Parts and Support Equipment Acquisition

1. Spare Parts Management in Perspective: Our spare parts acquisition and logistics system, while not perfect, is a very effective and efficient system. We support 122 active bases and 150 Guard and Reserve installations as well as radar sites, ballistic missile locations, electronic combat operations sites and other auxiliary airfields. In all we support some 2,835 installations around the world. In the area of spare parts alone, the Air Force manages some 890,000 different types with an active inventory worth more than $38 billion. We process more than 4 million procurement actions each year. The system is large, complex, dynamic, and

employs thousands of people. Recognizing its size and complexity, we have worked hard to identify deficiencies and improve the system. As a result, many new procedures have been implemented that will correct faults in the system permanently. These changes are essential to insure that funding requests for spare parts will result in maximum improvements to readiness and sustainability.

2. Impact of Air Force Internal Studies: The basis for these improvements has been a series of major studies undertaken by the Air Force over the past years to uncover the reasons for high spare parts costs. The Air Force's own internal oversight and review systems revealed that significant savings could be realized through tighter management actions. The Air Force has aggressively implemented the vast majority (over 95%) of the specific recommendations which were identified during these studies.

a. Requirements Forecasting: The first spare parts initiatives involved a change to the requirements process. In April 1983, a study designated CORONA REQUIRE, was completed that recommended 26 different improvements to the Air Force's system for forecasting aircraft replenishment spares. All of the suggestions have been implemented. Some of the implemented actions include ADP programs which are on-going efforts and will not be fully operational until 1989. While CORONA REQUIRE has been closed out, the process of improving forecasting methodologies continues. We are constantly refining our forecasting models to better capture the multiple variabiles impacting spares forecasts.

b. Spares Pricing: The most exhaustive spare parts study ever under-taken by the Air Force was produced by the Air Force Management Analysis Group in October 1983. The 62-member group of logistics and contracting professionals made 178 recommendations which have served as the Air Force's guidepost for solving the overpricing problem. The group found that as a result of spares underfunding and a lack of manpower, the acquisition process had not focused on low value spares contracts. A lack of competition, limited data, manpower constraints, and ineffective pricing techniques were evident. A General Officer Steering Group at Headquarters Air Force continues to direct and monitor implementation of these recommendations by Air Force acquisition personnel at all levels. It is our intent to make these system changes institutional to preclude recurrence. Of the 178 recommendations, 168 (94%) are now completed.

c. Support Equipment Review: Support equipment for our weapon systems is bought in small quantities, but in large lots of diverse items. Support equipment development and purchases must parallel the weapon system development and production to ensure a supportable system is placed in the field. In March 1984, a Support Equipment Acquisition Review was completed analyzing this process carefully. Nineteen areas were identified for improvement in forecasting, planning, and pricing. Controls have been implemented to deter the proliferation of support equipment. The General Officer Steering Group is directing the progress of initiatives stemming from this effort. Of the 128 specific initiatives identified, 122 (95%) are completed. Most initiatives will be implemented by February 1986.

3. Replenishment Spare Parts Breakout: The Department of Defense Spare Parts Breakout Program is a major management enhancement that demands the identification of parts that can be procured competitively or from actual manufacturers rather than from the prime contractor. To accomplish that goal, Air Force Logistics Command's Competition Advocates screen anticipated buys for

potential breakout to the actual manufacturer. Ninety-seven percent of the candidate items reviewed in Fiscal Year 1985 were coded for competition or breakout. In Fiscal Year 1987, we expect the breakout program to continue increasing competition among Air Force contractors, reducing sole source procurements, broadening the industrial base, and lowering prices for spare parts.

4. New Policy on Spare Parts Retention: We are continuing to stress a philosophy of retaining spare parts. Previously, we viewed the disposal of spare parts in our economic interest if the inventories exceeded specific long-term usage projections. Instead of facing the potential that discarded parts might be repurchased, we now direct that Air Force managers retain parts as long as we have systems that require them. It should save money and contribute to our readiness. The Secretary of the Air Force directed a five-point program in 1984 that began with a moratorium on all disposal actions. We are pleased to report that new procedures are now in place to implement the five-point retention program and the moratorium has been lifted.

## D. People Programs

1. Objectives: The professionalism of the acquisition management community is an issue of major importance not only to the Air Force, but also to Congress and the American public. The Air Force acquisition community is the best trained and most professional in the government. Our acquisition management initiatives are designed to develop an even more professional, and better qualified cadre of acquisition personnel. Training, education, and experience are focal points in our management of personnel resources.

2. Acquisition Career Field: The Air Force has long recognized the need for a well-qualified acquisition community and is a leader in acquisition training and career development. Our acquisition career field offers progression paths to General Officer and Senior Executive Service levels, and our personnel are among the best trained in DoD. Air Force training and career development programs have proved successful, and we have provided OSD with information gained from our experience for formulation of an OSD position on training, education, and experience objectives. We are continuing to work with OSD in development of ways to improve the professionalism of our acquisition work force, including requiring a baccalaureate degree, mandating additional and specialized training, and specifying experience and tenure requirements.

3. "COPPER TOP": Project "COPPER TOP" was begun to examine current training shortfalls within the contracting work force. A planning team was organized to size requirements, identify problems with the training system, develop alternatives, and prepare a plan for corrective action. Extra funding in the Fiscal Year 1986 DoD Appropriation combined with the current Five Year Defense Plan will help correct a 60 percent shortfall in the completion of mandatory training courses. Current action items include establishment of mandatory training requirements for the GS-1910/QA Series, establishment of a mandatory Contracting Officer course, and participation in course reviews.

4. PALACE ACQUIRE: The Air Force PALACE ACQUIRE is a centrally-managed and funded competitive intern program. This initiative was established in 1985 and is targeted to recruit recent quality college graduates to entry-level GS-5/7 trainee positions in a variety of occupational fields. The program scope is based on work force analyses of turnover rates, mission, and technological changes. The

contracting career field, for example, is already experiencing a turnover rate that is 13 percent above other career fields and the Air Force projects a 20 percent loss of contracting professionals due to retirements alone in the next five years. PALACE ACQUIRE helps to maintain civilian work force stability and expertise in major functional areas by providing a pipeline of available and highly-skilled civilian employees. PALACE ACQUIRE has been approved as a Fiscal Year 1987 initiative.

5. **Performance Standards**: A pamphlet incorporating newly developed performance elements and standards for contracting and acquisition personnel is scheduled for publication in 1986. Such standards recognize the need to increase competition, create dual sources, break out items from prime contractors, negotiate effectively, and price hardware on the basis of its intrinsic value. Other career areas are similarly receiving a comprehensive review to determine that performance standards reflect our concerns about cost consciousness and competition.

6. **Rewards**: The Air Force has established a specific award to recognize contracting personnel who excel in obtaining competition. The award, called the "Outstanding Contribution to Increased Competition Award," was established and first presented in 1983. This annual award provides for continuing emphasis on competition. Another new award, "The Air Force Professionalism in Contracting Award" was established in 1985. Presentations were made to the first recipients in August 1985. The award, in recognition of demonstrated dedication and professionalism on the part of contracting personnel, is presented to emphasize the Air Force's high level of interest in enhancing professionalism in the contracting work force.

7. **Summary**: The Air Force acquisition workforce remains unsurpassed within the government. Our goal is to develop an even more professional, better qualified, acquisition management work force in order to develop and refine the Air Force acquisition management process. People are an integral part of the process. The most effective improvements come from within, from the people with the education, training, and experience necessary to identify the real problem and propose solutions. Our efforts to date have resulted in significant improvement and cost savings. It is our corporate objective to continue to pursue new opportunities to improve our work force and the acquisition process.

## E. NATO Armaments Cooperation

1. **Early Program Involvement**: Success in cooperative development programs is greatly enhanced by initiating the NATO cooperative program early in the development cycle. Indicative of our emphasis on such programs are three feasibility studies with several different NATO partners. They are the Long-Range Standoff Missile (LRSOM), the Short-Range Anti-Radiation Missile (SRARM), and the Low Cost Powered Dispenser (LOCPOD). While we have no commitment to go beyond the feasibility study phase, we intend to proceed into a full scale cooperative development program if the results of the study prove favorable.

2. **Mature Program Involvement**: We have several major cooperative programs with our NATO allies that go far beyond feasibility studies. In the coming year we plan to implement the Eifel $C^2$ System upgrade with Germany, the imaging infrared Maverick Co-production program with Italy, and will continue the Four-Power Memorandum of Understanding on Family of Advanced Air-to-Air Missile

Systems (AMRAAM/ASRAAM). For additional information on these latter two missiles, refer to Section VIII, Theater Forces.

3. Future Cooperation: We anticipate that Air Force NATO cooperative programs will increase over the next few years. The Nunn Amendment to the Fiscal Year 1986 Authorization Act, which set aside funds for NATO Cooperative R&D projects, gave us a much needed means to increase our cooperative involvement. As a result of that legislation, we will initiate cooperative projects during 1986 for a series of Modular Air Launched Stand-off Weapons. We expect these projects to evolve into full scale development programs over the next the years.

Reflecting both Congressional and OSD direction, we will assess the availability and suitability of NATO allies' development programs before we start new programs that are potentially duplicative. The Foreign Weapons, Equipment and Technology Evaluation (FWETE) program has resulted in several weapons entering our inventory without the attendant development costs. The French made Durandal Airfield Attack weapon for example is being bought by the Air Force after our evaluation under the FWETE program verified its suitability for the Air Force mission. In Fiscal Year 1986, the Air Force FWETE program increased over ten percent from Fiscal Year 1985 and we plan a similar increase in Fiscal Year 1987.

*WEAPONS LOADING COMPETITION*
*GUNSMOKE 85*

# III. READINESS AND SUSTAINABILITY

## A. Objectives

Air Force investment in force structure and modern weapon production may be translated into a war-fighting capability only if readiness and sustainability programs are functioning well. Success in combat requires a blend of modern equipment, well-trained people, effective repair facilities, sufficient spare parts, and adequate munitions and fuel.

Ready forces, on hand, form the basis of our capability to engage the enemy effectively on the first day of fighting. Readiness is the sum of proficiency and sufficiency, in forces, units, weapon systems and equipment. Readiness requires that forces be trained under realistic conditions and stocks of spares be available at the beginning of combat.

Aircrew proficiency in all of our modern weapon systems is at its highest level in years. Our tactical fighter proficiency was recently demonstrated in GUNSMOKE 85, USAF's worldwide fighter gunnery competition. GUNSMOKE 85 was held on October 6-19, 1985 at Nellis Air Force Base, Nevada. The events in the competition tested the pilot's ability to navigate at low altitude, arrive on time, on target, and destroy that target using actual wartime munitions dispensers. During low level navigation, the crews were required to evade surface-to-air threat simulators while maintaining precise course and timing criteria. In the navigation-attack mission competition, the top five teams all achieved a direct hit and arrived within less than a second of their respective scheduled times.

The tactical bombing competition showed equally impressive results and the F-16 Fighting Falcon, the tactical Air Force's newest fighter, took six of the top seven places of 17 teams. The Air Force's attention to modernization and training in the reserve forces over the past several years was rewarded by the excellent Air Force Reserve and Air National Guard (ANG) scores. An Air Force Reserve unit from the 419th Tactical Fighter Wing, Hill Air Force Base, Utah, flying F-16s, was the overall winner. AF Reserve/ANG units took four of the top ten places in the overall bombing competition. GUNSMOKE 85 demonstrated that the investment over the past five years in modern weapon systems like the F-16, and training for both air and maintenance crews, has paid off in significantly increased readiness and combat capability.

Sustainable forces, on the other hand, must have the "staying power" to fight during and beyond an initial period of combat. To do that, they depend on the nation's ability to generate adequate spares, supplies, munitions, and fuel to replace those resources consumed or attrited in battle. Moreover, sustainability results only when peacetime stocks, the support infrastructure, war reserve materiel, and the industrial base permit it.

Air Force materiel inventories are split into categories: peacetime operating stocks and prepositioned wartime assets. The categories equate to those "readiness" kinds of spares and equipment needed at the outbreak of war; and prestocked wartime requirements, which support "sustainable" fighting and depend on deeper stock levels and industrial surge.

Since 1981 the Air Force has sought to reduce the serious shortfalls in wartime stocks and at the same time keep the forces ready. This emphasis has brought clear tangible results. Today, our combat aircraft can fly over 83 percent more combat sorties in NATO than they could in 1981 and do so with more capable airframes. Further, an increase of 50 percent in the defense budget for sustainability programs between Fiscal Year 1982 and Fiscal Year 1984 resulted in an increase of over 65 percent in the number of sorties which can be supported with preferred munitions between 1983 and 1986.

## B. Aircraft and Missile Spares and Repair Parts

The strong support and momentum for funding readiness and sustainability stocks sustained through the first half of this decade have diminished in the face of the nation's increasingly austere fiscal climate. This is reflected in the Fiscal Year 1986 budget as well as the Fiscal Year 1987 fiscal guidance. Because of the two-year average lead time to procure spares, the Fiscal Year's 1986 and 1987 reductions will begin to impact our readiness posture in Fiscal Year's 1988 and 1989.

To understand the impact of these reduced funding levels, it is necessary to first define the various segments of spares support.

Peacetime Operating Stocks (POS) are those spare and repair parts that support the day-to-day readiness objectives of the Air Force. They are needed for combat forces training, continuation of daily operations, and assurance that our weapon systems are ready to perform their wartime mission. Our POS procurement consists of two distinct elements --initial spares and replenishment spares. Initial spares include items to support early operations of newly-delivered aircraft and missiles. The account also funds spare engines, initial support for simulators, modifications and ground support equipment. This segment provides the inventory base of spare parts to which our wartime stocks are added.

Included in this fiscal year's initial spares request are spare engines for F-15 and F-16 fighter aircraft, the cornerstones of our tactical forces. In addition, our Fiscal Year 1987 request includes emphasis on the F-15E dual role fighter, the Peacekeeper strategic missile, and the C-5B transport aircraft. Our Fiscal Year 1987 request also includes our estimate of the initial outfitting costs of additional weapon systems that have been in production for some time. This is in consonance with a new DoD definition of initial spares -- what the Air Force calls "New Acceptance Spares".

The second POS element, replenishment spares, is required to provide continuing support throughout the life cycle of a system. Adequate funding of replenishment spares is critical if we are to support our flying hour and missile alert programs and be ready to go to war.

In addition to POS, we must provide war reserve stocks and inventories which are necessary to satisfy wartime requirements. We group these materiel requirements into two categories. The first, War Readiness Spares Kits (WRSK) and Base Level Self-Sufficiency Spares (BLSS), are provided to support initial combat operations, but are only designed to carry us through the initial stages of conflict. A second category of reserves, Other War Reserve Materiel (OWRM), is designed to provide the sustainability needed until the industrial base can react.

The Fiscal Year 1987 budget for replenishment spares reflects the cumulative effects of reduced appropriations in Fiscal Year 1986 and fiscal guidance in Fiscal Year 1987. Our budget requests $2078 million for POS and $472 million for WRSK/BLSS. This represents a decision to finance the AF replenishment spares account at 56% of our total Fiscal Year 1987 requirement. Our request places emphasis on funding what we consider our highest spares priority -- the POS requirement. The Fiscal Year 1987 budget request supports 100% of this vital requirement. It is in the area of our war reserve stocks and inventories that the new fiscal climate is most seriously affecting us. For example, our budget request supports on 24% of our aircraft WRSK/BLSS requirement. This will allow us to buy only our Fiscal Year 1987 new kit authorizations and a small percentage of our kit update requirements. Moreover, there are no funds available for aircraft OWRM sustainability stocks in Fiscal Year 1987. The Air Force is concerned over these reductions and is dedicated to achieving required levels of readiness and sustainability in Fiscal Year 1988.

The Air Force Stock Fund (AFSF) procures consumable bits and pieces needed for spares asset repair and maintenance. Full funding of AFSF requirements helps to maintain higher overall levels of spares availability. However, fiscal constraints have also reduced AFSF funding further compounding the management task required to sustain gains in readiness and sustainability made earlier.

For missile spares and repair parts continued Congressional support is indispensible to maintaining our present high mission capable rates. In Fiscal Year 1987 in particular, funding continuity is needed to sustain the extended operational life of the Minuteman ICBM force while establishing essential initial support capabilities for Peacekeeper and a number of other new missiles.

Readiness and sustainability are the products of continued support for many items reflected in other appropriations, such as munitions, bare base equipment, vehicles, fuel, other procurement equipment spares and repair parts, depot maintenance and military construction. In addition to spares and repair parts, those items controlled within the budget categories under consideration include: war consumables, simulators and trainers, modifications, and aircraft common ground equipment.

## C. War Consumables

War Consumables are aircraft alternate mission equipment items required to configure combat aircraft to a variety of employment roles. An example is the F-16, which needs one combination of external fuel tanks and missile launchers for its air-to-air role and a different combination of external fuel tanks, missile launchers, and bomb racks for its air-to-ground role. These items are generally capable of being jettisoned during combat to reduce drag, increase speed, and improve maneuverability. As a general rule, items funded in this category are War Reserve Materiel stocks. However, Peacetime Operating Stocks for improved war consumable items for older inventory aircraft are also funded in this category. Inventory support equipment, such as storage and transport containers unique to War Consumables, are also funded here. War Consumables are absolutely essential for readiness training in peacetime and for sortie sustainability support in wartime. Inventory requirements are dependent on current and projected aircraft inventories, employment roles, tactics, combat sortie rates, and expected combat expenditure-per-sortie factors.

In Fiscal Year 1987, we have requested funds to continue filling War Reserve Materiel requirements for the F-16 aircraft's 370-gallon wing tank and pylon. We are also requesting funds to procure the last increment of War Reserve Materiel stocks of the LAU-117 single-rail Maverick missile launcher for various tactical aircraft and the last increment of the electronic adapter units for the LAU-88 triple-rail Maverick launcher to upgrade that launcher to accommodate the wide variety of aircraft and Maverick missile combinations now in use. This budget also requests initial funding for LAU-128 and LAU-129 launchers to match the scheduled upgrades of F-15 and F-16 aircraft to the Advanced Medium Range Air-to-Air Missile. These launchers can also launch current inventory AIM-9 missiles. They provide a vast improvement in reliability and maintainability over our current AIM-9 launchers, in that the LAU-128 and LAU-129 incorporate a more reliable and more easily replaceable modular power supply.

## D. Simulators and Training Devices

Combat aircrew proficiency is the ultimate force multiplier. It requires realistic training in a total systems environment that includes both the weapon system and a family of training devices and training aids. Through the use of simulators and training devices, we are able to compliment our highly valued flight time, to enhance combat capability, and at the same time improve safety.

The nation's investment in modern simulation results in increased mission readiness through more efficient and effective training. Training devices are used to train war fighting skills that are not easily trained in the aircraft because of equipment and weather limitations as well as airspace restrictions. We also use our ground based devices to train safety-of-flight tasks and emergency procedures that require flight conditions that are either difficult to achieve or not prudent to accomplish in the aircraft. By practicing these tasks in training devices, the use of simulation makes our flight time more effective, more efficient, and provides us with crews who are better prepared to defend our nation.

We currently have simulators for most weapon systems, including the F-4, F-111, F-15, F-16, and A-10 fighter aircraft, C-5, C-141, and C-130 transports, KC-135 and KC-10 tankers, T-37 and T-38 trainers, B-52 bomber, and E-3 Airborne Warning and Control System. Introduction of new aircraft, technological improvements such as visual systems and logistical requirements such as conversion from analog to digital technology mandate a need to continue support of simulators and training devices.

In Fiscal Year 1986, we fielded our first C-5/C-141 Aerial Refueling Part Task Trainer, a B-1B Cockpit Familiarization Trainer, and our first EF-111 Operational Flight Trainer (OFT). We started refurbishment of our KC-135 OFTs that help us convert from analog to digital technology and also began development of a simulation capability for the Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN). Development continued in Fiscal Year 1986 on the F-15E Dual Role Fighter, C-5B update, and F-16C/D simulators. These development activities will continue in Fiscal Year 1987.

The Fiscal Year 1987 budget request will continue procurement of the F-15, F-16, B-1B, KC-135, and LANTIRN simulators systems. Extensive front-end analysis will begin for the Advanced Technology Bomber, the Advanced Tactical Fighter, and C-17. In addition, development will continue to advance the simulation technologies necessary to complement our flight time and improve our combat aircrew proficiency.

## E. Modifications

The decreasing number of new aircraft has necessitated the modification of the in-service fleets of Guard, Reserve, and Active Duty aircraft to extend their safe service life, increase their reliability and maintainability, and increase their capability to meet the emerging enemy threat. Extending the service life of aircraft beyond the original design will require structural improvements to the F/RF-4, C/KC-135, and T-38. Also required will be modifications to replace obsolete electronic technology, which is becoming increasingly more difficult and expensive to support. With the solid-state chips and digital technology comes increased reliability which will more than pay back the cost of modifications through reduced depot support costs and maintenance manhours. Digital inertial navigation systems will be installed in the F/RF-4, A-7, and the F-15; autopilot updates will be accomplished on the C-130 and C-141; and weapons delivery improvements will be made to the F/FB-111 and the F-4. Incorporation of more durable components in the engines of the C-5, F-15, F-5, and A-10 will reduce the frequency of engine changes and decrease the possibility of in-flight failures.

The greatest number of increases in capability will be in the areas of airborne command, control, and communication; special operations forces; and navigation. Numerous improvements in radios on board the E-3, E-4, and fighter aircraft will permit rapid secure jam-proof communications and coordination with ground and airborne forces. Increasing the sensor capability of the special forces aircraft and helicopters will enhance their capabilities to handle threats in counter insurgent and limited warfare situations. The modification of seven different aircraft to use the Navstar Global Positioning System is the beginning of a program which will eventually give almost every aircraft a pinpoint navigation capability based on satellites.

## F. Aerospace Ground Equipment

The Fiscal Year 1987 budget request provides common support equipment for new aircraft entering the inventory and for aircraft being modified, as well as replacement equipment for out-of-production aircraft. Common ground equipment is used on the flight line, in base maintenance shops, and at centralized maintenance activities and supports launches, maintenance, servicing and testing of aircraft and their components. Examples of common ground equipment included in this budget request are noise suppressors, ammunition loaders, radar test sets, and air compressors.

B-52 CREWS RESPONDING TO AN ALERT EXERCISE

# IV. Strategic Offense

## A. Objectives

The United States' strategic offensive forces are composed of a Triad of sea-launched ballistic missiles, land-based intercontinental ballistic missile (ICBM) , and manned bombers. These forces perform two vital and interrelated functions which directly support our national security objectives. First, the strategic offensive forces serve as a deterrent to any potential aggressor. The potential aggressor must perceive that we have sufficient forces to retaliate in a conflict and that the United States has the resolve to use those forces. The second function contributes to this perception by ensuring that, if deterrence fails, the United States possesses both the weapons and the resolve to fight and meet our national security objectives. This Triad not only provides the flexibility and capability to discourage a first strike against the United States, but it also complicates Soviet efforts to defend against this retaliatory mix of forces.

The Air Force is responsible for maintaining two-thirds of the Triad, land-based ICBMs and the manned bomber. Within these areas, we have continued the modernization program initiated by the President in 1981. We can see the fruits of our labor and the significant investment. We are modernizing our ICBM fleet through the upgrade of our Minuteman force and the acquisition of a new missile, the Peacekeeper. Our bomber force is also seeing new life. We have upgraded some of the systems on our B-52s which further extends their lifetime and we are seeing the delivery of our new B-1B bombers. The B-1B is the first new strategic bomber in more than twenty-five years. Looking to the future, our programs are progressing on schedule, and we are continuing to provide the mainstay of our nation's defense.

## B. Intercontinental Ballistic Missiles

### BACKGROUND

1. Rationale: The United States' intercontinental ballistic missile leg has three central purposes. First, ICBMs help deter Soviet threats of massive conventional or nuclear attack by virtue of their ability to respond promptly and controllably against even the hardest of military targets. Second, ICBMs introduce complexity and uncertainty into Soviet attack plans because different types of attacks are required to defeat our ICBM, submarine, and bomber forces. Third, the ICBM force serves as a hedge against possible vulnerability in our submarine force (e.g., a Soviet breakthrough in anti-submarine warfare).

2. Current Systems: Our present ICBM force is more than two decades old. The Titan II missiles were deployed in the early 1960s and the Minuteman shortly thereafter. As a result of the age and the associated maintainability problems, the Titan IIs are being retired and the Minuteman missiles are undergoing modification to upgrade their capabilities. Our ICBM modernization stems from the need to redress the strategic asymmetry caused by the massive Soviet ICBM build-up which began in the early 1970's. Since then, the Soviet Union has deployed more than 800 SS-17s, SS-18s, and SS-19s that have good to excellent

accuracy and payloads as large or larger than Peacekeeper's. Meanwhile, more than half of the Soviet ICBM force has been deployed since the last U.S. ICBM deployment.

To address the strategic imbalance, the President endorsed the ICBM Modernization Program in April 1983. The program was recommended by the President's Commission on Strategic Forces (Scowcroft Commission) and subsequently approved by the Congress. This program was built on the recognition that all ICBM tasks cannot be served by a single weapon system. Accordingly, the Commission recommended (1) promptly deploying 100 Peacekeeper missiles in existing Minuteman silos; (2) initiating engineering design of a single warhead ICBM leading to deployment in the early 1990s; and (3) vigorously investigating follow-on basing technologies, including hardened vehicles and silos.

Our present operational ICBM force consists of Titan II and Minuteman II and III missiles. We have retired 34 of our 52 Titan IIs and the remainder will be phased out by October 1, 1987. The mainstay of this force is our Minuteman. Within this weapon system we have a total of 1000 missiles with 50 of the Minuteman IIIs programmed to be replaced by 50 Peacekeepers.

3. Future Systems: Future initiatives in the ICBM area include studies and research which could support alternate basing for the remaining 50 Peacekeeper missiles, research and development on a small ICBM and the technology developments within the Advanced Strategic Missile Systems program.

## Fiscal Year 1987 Programs

### 4. Minuteman Squadrons

a. MISSION: The Minuteman weapon system became operational in the 1960s and now consists of 450 Minuteman II and 550 Minuteman III (50 to be replaced by Peacekeeper). Minuteman has served as a prime nuclear deterrent force for the United States for 23 years and is projected to maintain this role into the next century. The program element (PE) provides for operations and maintenance of the deployed force as well as improvements and modifications to the Minuteman force to enhance its contribution to strategic deterrence.

b. STATUS: Enhancements and modifications are being made to the Minuteman weapon system to maintain viability of the force, to improve operating efficiencies, and to maintain compatibility with other Single Integrated Operational Plan (SIOP) forces. On the missile itself, the motors for the second stages of the Minuteman II and III boosters are being washed out and repoured and the Minuteman III, Stage 3 motors are being remanufactured to correct an age-related degraded propellant liner condition. The Minuteman II missile guidance set began its Accuracy Reliability Supportability Improvement Program in Fiscal Year 1986 to replace degrading electronic parts, increase accuracy, and provide remote retargeting/expanded execution plan capability. Minuteman III completes a guidance upgrade program in Fiscal Year 1986 to improve its accuracy. A full scale development program begins in Fiscal Year 1987 to add decoys and new chaff to a portion of the Minuteman III force. These penetration aids will ensure the missiles' continued effectiveness against defended targets. On the ground, the Rivet Mile program, which began in Fiscal Year 1985, continues to perform depot level maintenance on launch facilities (LFs) and launch control facilities (LCFs).

*DUAL MINUTEMAN II LAUNCH FROM VANDENBERG AFB, CALIFORNIA*

There are numerous Class IV modifications underway or starting in Fiscal Year 1987 to support reliability and maintainability upgrades. The more important of these replace the outer zone security systems at the LFs, replace nonsupportable electronics equipment at the LFs and LCFs, and replace the splice cases in the hardened intersite cable system.

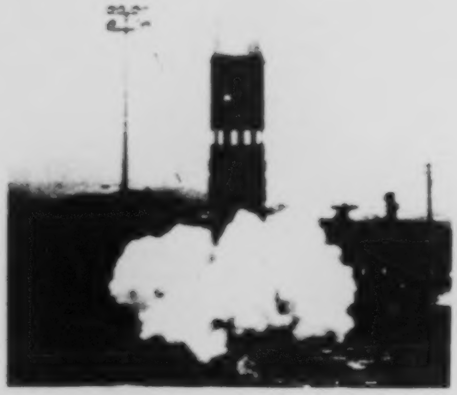
The Single Class V modification continues a program started in Fiscal Year 1984 to procure and deploy new high-density rechargeable emergency batteries in those 200 Minuteman III LFs that have had lithium batteries installed under the Minuteman Extended Survivable Power (MESP) program. The lithium batteries increased the silos' wartime emergency power time by a factor of 15, but they cut the peacetime emergency power time in half. (Because they are expensive and nonrechargeable, their one-time use is saved for wartime.) Correcting this deficiency to avoid damaged equipment and missile off-alert time is a high priority.

Finally, aging support equipment such as transporter-erector vehicles and wing and depot test equipment is being replaced. These and other programs will keep Minuteman a credible part of the nuclear deterrent force beyond the year 2000.

### 5. Peacekeeper

a. **MISSION**: The main purpose of deploying the Peacekeeper missile system beginning in December 1986 is to more effectively deter Soviet threats of massive conventional or nuclear attack against the United States and our allies. By virtue of its improved damage expectancy against hardened military targets, Peacekeeper accomplishes several strategic objectives. First, the near-term Peacekeeper deployment begins to offset Soviet counterforce advantages created by the Soviet ability to destroy hardened U.S. land-based targets. Peacekeeper has the range, yield, and accuracy to place at risk all Soviet target types--hardened and unhardened--with the most reliable and responsive leg of the Strategic Triad. Second, deploying Peacekeeper in existing Minuteman silos helps redress the aging problem of the U.S. ICBM force by reducing the risks of a catastrophic age-related reduction in MM III reliability. Third, Peacekeeper deployment encourages the Soviet Union to negotiate stabilizing arms control agreements by providing a tangible incentive to move toward less valuable deployments. Thus, the Peacekeeper deployment is the first step toward enhanced deterrence, increased strategic stability, and meaningful arms control negotiations.

b. STATUS: The Peacekeeper is a four-stage ICBM configured to deliver up to 10 Mark 21 reentry vehicles to different targets. Peacekeeper uses a state-of-the-art Advanced Inertial Reference Sphere guidance system to attain its high degree of accuracy. Peacekeeper is more accurate, carries more warheads, has greater range, and is more resistant to nuclear effects than other ICBM systems currently in the U.S. inventory.



***PEACEKEEPER INTERCONTINENTAL BALLISTIC MISSILE FIRST SILO TEST LAUNCH***

The Peacekeeper research and development flight-test program, consisting of 20 planned launches, was initiated at Vandenberg AFB, California, in June 1983. Phase I of the flight test program, completed in June 1984, was designed to test missile functional performance. Phase II is designed to test missile/reentry vehicle capabilities and silo integration. Ten launches, all successful, have been completed to date. Flight test 9, the first launch from an operationally configured silo, was successfully completed in August 1985. Flight test 10, the second silo launch, was successfully completed in November 1985. Peacekeeper accuracy is outstanding with demonstrated results considerably better than the design requirement.

The Peacekeeper missile deployment in southeastern Wyoming will be supported by the 90th Strategic Missile Wing at F.E. Warren AFB, close to Cheyenne. Fifty Peacekeeper missiles will replace 50 Minuteman missiles in existing silos. Very little silo structural modification will be needed. Initial Operational Capability of ten missiles is scheduled for December 1986. The 50 missiles will be fully deployed in existing silos by December 1988.

Full scale development for basing began in June 1983. A draft Environmental Impact Statement was issued in October 1983. Public hearings were held in early November, and the final statement was released in January 1984. Construction of support facilities began in mid-1984 and above ground silo modifications began in early 1985.

In 1984, the Peacekeeper program began the transition from full scale development to production. Twenty-one production missiles were authorized in Fiscal Year 1984; an additional 21 were authorized in Fiscal Year 85. Fiscal Year 1986 production has been set at 12 missiles will be and a total of 50 missiles deployed in existing Minuteman silos.

Congressional concern in Fiscal Year 1986 with the issue of vulnerability of existing silos resulted in an Fiscal Year 1986 Authorization limitation of 50 Peacekeepers deployed in existing Minuteman silos. While individual existing silos would be vulnerable to large nuclear detonations, the overall retaliatory capability of our strategic TRIAD poses a formidable attack problem for any adversary, thereby assuring the ICBM component has sufficient survivability to carry out its prompt retaliatory deterrent mission. To provide the additional survivability desired by the Congress, we are examining alternative basing modes for the additional Peacekeeper missiles. Eight candidate basing modes are under consideration and include; shallow tunnel (hardened trench), hardened Minuteman silos, superhard silos, superhard silo with transportable launcher, mobile encapsulated (carry hard) basing, rail mobile, ground mobile, and deep underground basing. These basing options were selected for further study previously because of recent advances in basing technology. We do not intend to relook old studies, but plan to answer the question "What's new?". Study of these basing modes will continue in Fiscal Year 87 with a narrowing of alternatives to the most promising candidate in preparation for a potential Fiscal Year 1988 Full Scale Development (FSD) start.

Peacekeeper production, deployment and support activities are on schedule and within cost. Fiscal Year 1987 funding will be used to continue missile production, conduct testing and evaluation, construct support facilities, and plan for deployment of the second 50 Peacekeepers.

### 6. Small ICBM

a. MISSION: The main purpose of deploying the Small Intercontinental Ballistic Missile (ICBM) is to seek improved stability in the ICBM force through reduced target value and improved survivability. By virtue of its improved survivability, single war head characteristics, and prompt hard target kill, the Small ICBM accomplishes several strategic objectives. First, improved survivability improves deterrence by increasing Soviet uncertainty that they could successfully attack the U.S. Second, the Small ICBM is capable of threatening unacceptable damage to those hardened Soviet assets most critical to Soviet war aims. Finally, single reentry vehicle (RV) weapons will fulfill critical missions throughout the conflict spectrum. In conjunction with Peacekeeper, SICBM is an important step forward enhanced deterrence.

The Department of Defense and the Air Force are continuing the development of the Small ICBM and hardened mobile launcher. In July 1983, the Air Force convened the Small Missile Independent Advisory Group (Schriever Commission). The Schriever Commission recommended a three phased program approach which included concept definition, pre-full scale development, and full scale development phases. In July 1984 the Air Force appointed a general officer to direct the Small ICBM Program Office development and acquisition strategies for both the Small ICBM and basing technology programs.

The President's Commission on Strategic Forces (Scowcroft Commission) recommended that the Air Force develop a small single RV missile. This missile will be flexible in terms of basing and potentially more survivable than current systems. The Small ICBM will present a relatively low-value target and require a high exchange ratio from the attacker. Therefore, in addition to hard target capability and responsiveness comparable to Peacekeeper, the Small ICBM will be survivable, stabilizing, and further enhance the arms control process.

***SMALL ICBM HARD MOBILE LAUNCHER MOBILITY TEST VEHICLES***

In order to meet the Small ICBM goals set forth by the President's Commission on Strategic Forces, the Office of the Secretary of Defense and the Air Force are directing top-level management attention to the program. The OSD Small Missile Review Panel, the SecDef Periodic Review, and the Small Missile Steering Group were established to ensure an aggressive Small ICBM program which would meet critical milestones and result in a 1992 Initial Operational Capability.

b. STATUS: The concept definition phase began in 1983 and was completed in late 1984. It involved building on Peacekeeper advanced technology as well as assessing alternative technologies. As a result of the concept definition, pre-full scale development began in late 1984. To date, more than 18 Small ICBM competitive contracts have been awarded for this effort. They encompass efforts in propulsion, hard mobile launcher, hard silo, guidance and control, launch control system, and assembly, test, and system support. The propulsion contractors have tested full scale prototype motor stages, exit cones, thrust vector control systems, and internal and external insulations. Full-scale stage testing will continue in 1986. The full scale development phase for the basing mode or modes will begin in Fiscal Year 1987. This program will lead to flight testing in 1989 with IOC in 1992.

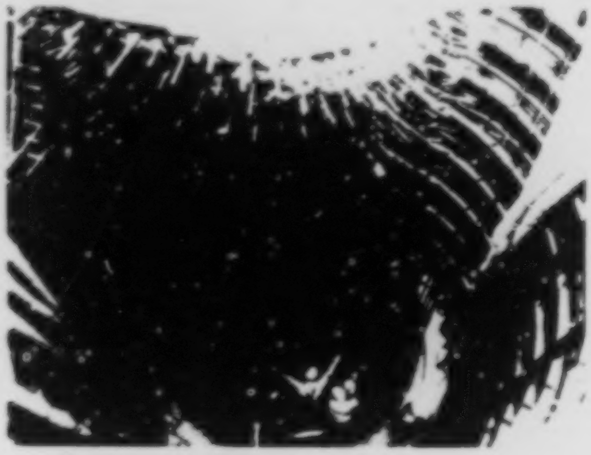
To date, we have tested scale models of the hard mobile launcher (HML) at the DNA sponsored Direct Course (9-83) and the Minor Scale (6-85) High Explosive Event as well as in the 20-ft diameter shock tube at the Sandia Blast test facility. The hard mobile launcher hardness validation will continue in 1986. Both Martin Marietta and Boeing have built HML Mobility Test Vehicles (MTV) that replicate HML size, weight, horsepower, and handling characteristics. Both MTV rollouts occurred in September 1985 and the two contractors began MTV testing. The Air Force will begin mobility testing in early 1986 on these two vehicles.

Efforts in the Small ICBM Guidance research and development continue in initial development. To decrease system weight, decrease reaction time without degrading system accuracy, and reduce unit cost, we are evaluating three alternative inertial navigation guidance systems as competitors to the baseline modified Peacekeeper Advanced Inertial Reference Sphere (AIRS). Alternatives include two ring laser gyro and one stellar inertial system. This competitive guidance effort will continue thru Fiscal Year 1988 when a primary guidance system will be selected.

### 7. Advanced Basing Technologies

a. MISSION: The Scowcroft Commission recognized the need for continuing to evaluate a broad range of candidate basing modes for follow-on missile deployment. We are evaluating several technologies including superhardened silos, deep undergound basing, shallow tunnel, and several mobile modes. These technologies are applicable to Peacekeeper or Small ICBM follow-on deployments.

b. STATUS: The Air Force and Defense Nuclear Agency began a three-year program in 1983 to demonstrate and validate superhard silo technologies through large-scale tests. Testing of silo component materials began in 1983 and continued through 1985 with impressive results. Congressional restraints on funding have reduced the scope of the effort and have eliminated further ultrahard testing planned for 1986. Nonetheless, subsize silo test and component tests have been quite successful, providing confidence that hardness in excess of 50 times existing silo hardness is achievable.



*SUPERHARD TEST SILO CONSTRUCTION*

Significant progress was also made in deep basing technology development and subsystem engineering and demonstration. Technology development efforts are concentrated on the effects of nuclear weapons on deep underground facilities; evaluation of alternative power, heat sink and life support systems; through-the-earth communications; and improving tunneling technology. Subsystem engineering efforts successfully demonstrated the technology for missile egress, launch, power, and heat sink systems. Fiscal Year 1987 funding will support further efforts involving concept definition and system configuration.

### 8. Advanced Strategic Missile Systems

a. MISSION: Advanced Strategic Missile Systems (ASMS) is our continuing program that develops, applies, and proves ballistic missile technologies by conducting advanced development for operational ICBM applications. Our early development work is pursued to gain confidence in engineering feasibility of new technologies and concepts to ensure their readiness for full scale development (FSD) and to provide timely solutions for identified ICBM force deficiencies, mission changes, and evolving threats. The ASMS mission also includes conducting tri-Service intercontinental range flight testing of exploratory reentry vehicles (RVs) and penetration aid systems.

b. STATUS: Although ASMS technology supports ballistic missile, reentry, penetration, and basing system/subsystem developments, the majority of the Fiscal Year 1987 ASMS program focuses on penetration systems. The objective of these programs is to develop and flight test ICBM penetration system options to provide effective counters to ongoing Soviet ballistic missile defense (BMD) upgrades. Penetration options, such as RV replica decoys (active and passive), chaff, optical countermeasures, defense suppression vehicles, and evader maneuvering reentry vehicles will address the near-term BMD threats as well as develop the critical technologies to counter projected BMD capabilities. The passive decoy and improved chaff will complete advanced development and flight testing this year and transition into full scale development for the Minuteman III system. ASMS efforts are also being conducted to increase our RV accuracy and survival as a hedge against Soviet target hardening and expanded BMD capabilities.

*FLIGHT TESTING OF EXPERIMENTAL PAYLOAD*

## C. Manned Bombers

1. Rationale: The second and most flexible and versatile leg of the TRIAD is the manned bomber. The bomber interacts with the ballistic missiles to enhance overall force effectiveness. It provides insurance against an unexpected failure or reduced effectiveness of other strategic force elements. The manned bomber is recallable, reusable, and can deliver a wide range of weapons from nuclear to conventional gravity bombs, maritime ship attack missiles, short range attack missiles, and cruise missiles. The bomber can be launched for a show-of-force and it can be dispersed to a variety of locations. The manned bomber has the added feature that it can make real-time damage assessment during attack and it can also be redirected while in flight. The manned bomber has the most near-term capability to locate, identify, and strike strategic relocatable targets. Because the bomber carries a mix of gravity weapons and cruise missiles, it severely complicates the Soviet air defense problem.

2. Current Systems: For over a quarter of a century, the B-52 has served as the backbone of our strategic bomber force. The current B-52 fleet of 241 aircraft is augmented by 56 FB-111As.

Our bombers are capable of striking targets across a broad spectrum of conflict. In addition to their traditional nuclear role, bomber aircraft also have a conventional and maritime role. The B-52 has been modified to carry large conventional payloads of gravity weapons as well as the Harpoon missile. This has expanded the B-52's role to include sea lane defense, mine laying, and sea surveillance.

The B-52, as the mainstay of our bomber leg of the Triad, provides those unique characteristics which only a strategic bomber can provide: flexibility to respond with conventional or nuclear weapons in a tactical or strategic role on land or at sea and meet last second contingencies that arise in the target area; recallability after launch, and reusability with minimum turnaround time.

Because of the age and limitations of our existing bomber force, we have initiated a phased modernization program for our manned bomber. The B-52 has been modified to carry the Air Launched Cruise Missile (ALCM), assuming a role it will maintain into the 1990s. The newer B-52H aircraft will be capable of carrying 20 cruise missiles, 12 externally and 8 internally. By the end of the decade, the B-1B will be our primary penetrating bomber while the B-52 assumes a primary role as a cruise missile carrier with an added conventional role.

3. Future Systems: There are several programs that are designed to examine our future bomber requirements. These programs are integrating future war-fighting concepts and the necessary technologies to conceptualize these future weapon systems. Because of the sensitive nature of these programs, most of the work is classified and cannot be released through this document.

The Advanced Technology Bomber (ATB) program is part of the President's strategic modernization program. That program, announced on October 2, 1981, calls for the production of 100 B-1Bs and a continuing vigorous research and development program for the ATB.

The two bomber program is the most prudent approach to revitalize our bomber force. While the ATB will provide an important and significant improvement in our ability to deal with advanced air defense, it will not be available until the 1990s. The B-1B will be operational in 1986 and provide a near term response to redress the strategic balance. The B-1B will be able to penetrate Soviet defenses well into the 1990s allowing us to shift the oldest B-52s to less vulnerable and less demanding roles as standoff cruise missile carriers and conventional bombers. The older ALCM B-52Gs will be retired as the ATBs come on line. During the same time frame, the B-1B can shift to a shoot then penetrate role to compensate for improved Soviet defenses.

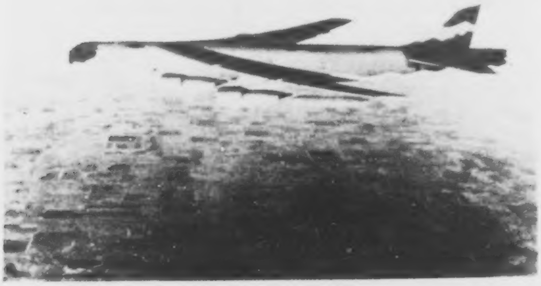
**B-52** – PENETRATE — SHOOT/PENETRATE—STANDOFF ——— (OLDEST RETIRE) ———
**B-1B** – PENETRATE ——— SHOOT/PENETRATE ———
**ATB** — PENETRATE ———

*STRATEGIC BOMBER MODERNIZATION PROGRAM*

## Fiscal Year 1987 Programs

### 4. B-52

a. MISSION: The primary role of the B-52 bomber is to deter war through its capability to effectively conduct operations throughout the spectrum of conflict. The primary mission area in which the B-52 will be employed is strategic airborne strike in support of the bomber leg of the strategic Triad. Collateral mission areas include elements of tactical land warfare, tactical air warfare, naval warfare, and theater nuclear warfare. The B-52's inherent capability to carry a wide variety of munitions over long distances provides flexibility in the nuclear and non-nuclear scenario.



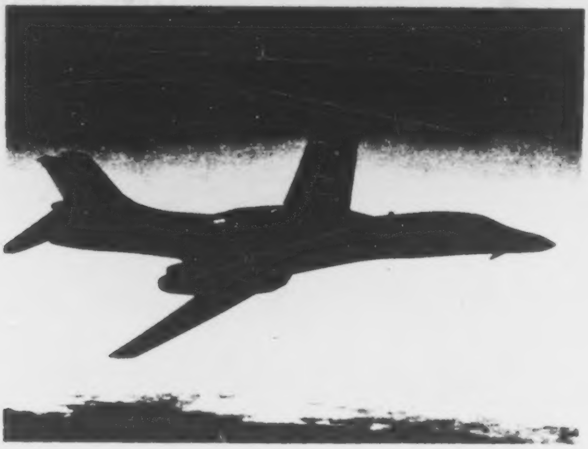
*B-52H BOMBER*

b. STATUS: We continue to modernize the B-52 to maintain it as a viable penetrator into the early 1990s. Major new capabilities will allow the B-52 to stand off from heavily defended areas and attack targets with conventional or nuclear weapons. The major B-52 modernization programs improve the electronic countermeasures, upgrade the airborne radar, and add internal cruise missile carriage capability. In the conventional arena, 69 non-ALCM B-52G aircraft will assume the bulk of the conventional commitment. We completed modification of 30 aircraft in June 1985 to carry the AGM-84 Harpoon anti-ship missile. The Strategic Conventional Standoff Capability program will provide these 69 non-ALCM B-52Gs with conventional improvements to put high value targets at risk through the 1990's regardless of the target environment.

### 5. B-1B

a. MISSION: The B-1B fills the need for a new multirole strategic bomber to be operational in 1986. The B-1B provides improved range and payload for the strategic nuclear bombing and cruise missile launch missions. In addition, the B-1B can perform tactical and strategic conventional bombing missions. The B-1B will serve initially in the penetrating role and later in the cruise missile shoot-and-penetrate role.

b. STATUS: On June 27, 1985, the Strategic Air Command took delivery of its first B-1B. The Fiscal Year 1987 B-1B RDT&E program concentrates on demonstrating and maturing the B-1B's operational capabilities. These activities will be conducted at Dyess AFB, Texas and Edwards AFB, California. The final lot of 48 B-1B's are procured with Fiscal Year 1986 funds. Initial operational capability will occur September 1986, with 15 B-1Bs at Dyess AFB, Texas. Full operational capability occurs with delivery of the 100th aircraft in the Spring of 1988



***B-1B BOMBER***

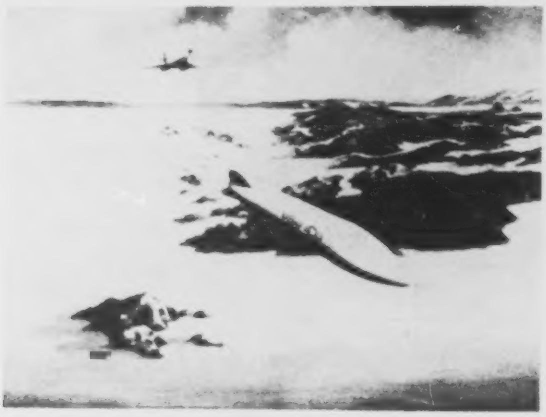
6. Advanced Technology Bomber

a. MISSION: The Advanced Technology Bomber (ATB) will follow the B-1B and is designed to ensure that our Triad force has the advantage of new developments in low observable technology to combat expected advances in Soviet defenses. The ATB program is part of the President's strategic modernization program announced on October 2, 1981. The two bomber program is the most prudent approach to revitalize our bomber force. The ATB will provide a significant improvement in our ability to deal with advanced air defenses.

b. STATUS: At the present time, development and procurement plans remain classified, but we can state that the RDT&E program is adequately funded, and within schedule for an early 1990s initial operational capability. The ATB R&D program is proceeding on schedule and at the fastest prudent pace. When delivered in the early 1990's the Advanced Technology Bomber will provide high confidence that our bombers can continue to penetrate Soviet defenses into the next century as well as providing the flexibility and other unique military characteristics that only a manned strategic aircraft possesses as an instrument for national objectives.

7. Short-Range Attack Missile II

a. MISSION: The Short-Range Attack Missile II (SRAM II) missile will provide an improved nuclear strike weapon to support the penetrating bomber mission. The weapon will replace the aging AGM-69A Short-Range Attack Missile . The B-1B and the Advanced Technology Bomber will be the primary carrier aircraft. SRAM II will provide an effective weapon used at standoff ranges against all classes of targets. Its flight characteristics prevent defense optimization against low signature subsonic weapons/weapon systems. SRAM II will ensure that our bombers are capable of striking multiple targets with a wide variety of weapons on a single mission.



*SHORT-RANGE ATTACK MISSILE II*

b. STATUS: SRAM II is in the system definition phase. Ten month study contracts were awarded in February 1985 to three competing contractors. Based on contractor data presented at the midpoint of these studies, the Air Force has chosen a rocket powered missile for SRAM II. The contractors then refined their rocket powered designs and are preparing to enter source selection. An initial development contract will be awarded in January 1987. Milestone II is planned for third quarter 1987 with flight test scheduled to begin in third quarter 1989. IOC is planned for Fiscal Year 1992.

### 8. Advanced Cruise Missile

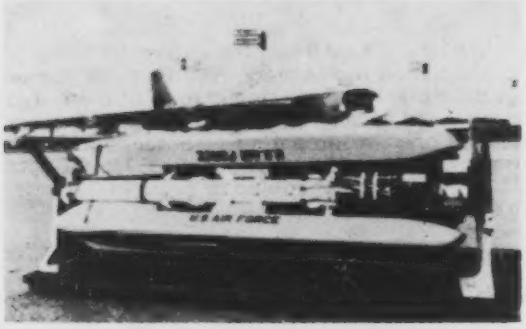
a. MISSION: To provide our bombers with a survivable standoff capability, the Advanced Cruise Missile (ACM) is being developed as a second generation cruise missile. The Advanced Cruise Missile (ACM) is a Presidentially approved, SECDEF directed, second generation cruise missile being developed to provide a logical and timely update to our ALCM force. In recognition of a finite cruise missile force and evolving Soviet capabilities, the ACM's substantial improvements in signature level, range, accuracy, and targeting flexibility will enhance the long-term effectiveness of our airbreathing force.

b. STATUS: We are continuing to develop the advanced cruise missile at the fastest prudent pace. The ACM will be deployed in a mix with the current generation cruise missile to maintain our bombers as a viable deterrent force.

A competitive source selection was concluded in April 1983 with the Full Scale Development contract for the ACM awarded. At the same time, a decision was made to procure an additional 240 AGM-86Bs in Fiscal Year 1984. A coordinated development/production approach will acquire the ACM at the fastest prudent pace.

### 9. Common Strategic Rotary Launcher

a. MISSION: The Common Strategic Rotary Launcher (CSRL) will provide the bomber force with growth potential and flexibility to assure its utility into the 21st Century. The CSRL is a multipurpose internal launcher for the B-52H, B-1B, and the Advanced Technology Bomber (ATB). The launcher will accommodate gravity weapons, Short-Range Attack Missiles, cruise missiles, and future conventional standoff munitions. Initially, the CSRL will be integrated into the 96 B-52Hs and later transferred to the B-1B as force structure changes. The CSRL will carry homogeneous loads of weapons on the B-52H and B-1B. The CSRL will also be compatible with the ATB.



*COMMON STRATEGIC ROTARY LAUNCHER*

b. STATUS: Ground testing of the CSRL was successfully completed in August 1985 and seven successful flight tests have been completed on the B-52H. In 1986, B-52H flight testing will end and B-1B CSRL flight testing will begin. The production contract for low rate initial production is scheduled to be awarded in February 1986. Full scale production is scheduled to begin in Fiscal Year 1987 leading to a B-52H initial operational capability in the second quarter of Fiscal Year 1990. We plan to procure a total of 104 CSRLs for 96 B-52Hs, which includes two spares at each of four operational bases.

*OVER-THE-HORIZON BACKSCATTER RADAR*

DEPARTMENT OF THE AIR FORCE
MCMXLVII
UNITED STATES OF AMERICA

# V. STRATEGIC DEFENSE

## A. Objectives

Strategic defense forces and systems are key elements of our deterrent posture. These forces form the backbone of our ability to warn of aircraft and missile attacks, monitor potential threatening activities, and defend against atmospheric and space-based threats to U.S. forces. They ensure that our National Command Authority's strategic retaliatory capability will survive any Soviet attempt at a first strike by providing timely, reliable, and unambiguous warning as well as attack assessment and ultimately damage limitation. Strategic Defense forces and systems are concerned with three basic threat areas: air, space and ballistic missile. The following sections address our balanced improvements in timeliness, flexibility, and survivability to counter the threat in the air, space and ballistic missile environments.

## B. Atmospheric Surveillance and Defense

### BACKGROUND

1. Rationale: Defense of North America against the air breathing threat is a joint U.S. and Canadian responsibility under the North American Aerospace Defense (NORAD) Command. Strategic air defense forces must provide timely, credible tactical warning and defense against enemy bombers, air-to-surface missiles and cruise missile attacks. These surveillance and defense forces control access to North American airspace in peacetime.

2. Soviet Bomber and Cruise Missile Threat: No longer is the Soviet air threat confined to high altitude bomber attack. Their capability has increased with the introduction and continued production of new bombers and improved air-to-surface missiles. New cruise missile-carrying BEAR bombers are in production. In addition, a new strategic bomber, similar to but larger than our B-1B, called the BLACKJACK, is expected to become operational during the 1980s. It will also have a cruise missile capability.

Most significant is the development and near-term deployment of cruise missiles. The Soviet air and sea-launched cruise missiles are the most severe threat to our capability to ensure adequate atmospheric tactical warning is provided to the National Command Authority. The modern threat has generated renewed interest in air defenses and the need for modernization.

3. Current Systems: Most of our operational air surveillance and defense systems were designed and deployed in the 1950's to meet a medium-to-high altitude bomber threat. Over the years, force cutbacks have significantly reduced the number of our radars and interceptor aircraft. Against today's low-altitude bomber and cruise missile threat, the capabilities of these systems are limited to very short ranges. These systems are also becoming increasingly expensive to operate and maintain.

To warn of an air attack today, we have only the aging and limited Distant Early Warning radar stations across northern Alaska, Canada, and Greenland, the Joint Surveillance System radars around the periphery of the continental United States, and some new radars in Alaska. We now have a modern command and control capability for these radars and fighter forces with the deployment of the Region Operations Control Centers.

4. Future Systems: The Over-the-Horizon Backscatter Radar and North Warning Systems are being developed to improve detection in our coastal and northern airspace. Also, an air interceptor modernization program will be initiated in Fiscal Year 1986 and procured in Fiscal Year 1987. Dual emphasis has been placed on improving performance against the modern Soviet bomber and cruise missile threat and reducing the cost of ownership.

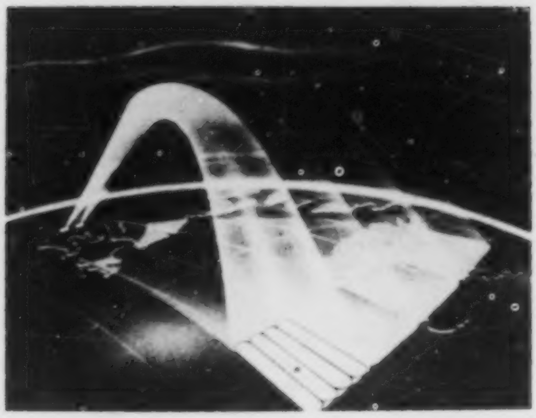
5. Air Defense Master Plan: Our planning for comprehensive modernization culminated in 1982 with a North American Air Defense Master Plan. This plan guided our acquisition strategy for fielding more capable air defense forces in the 1985-95 era. Under the lead of the NORAD commander, the plan was updated and a long-range planning annex completed. The master plan and annex provide guidelines for deployment of a modern air defense system.

## Fiscal Year 1987 PROGRAMS

### 6. Over-the-Horizon Backscatter Radar

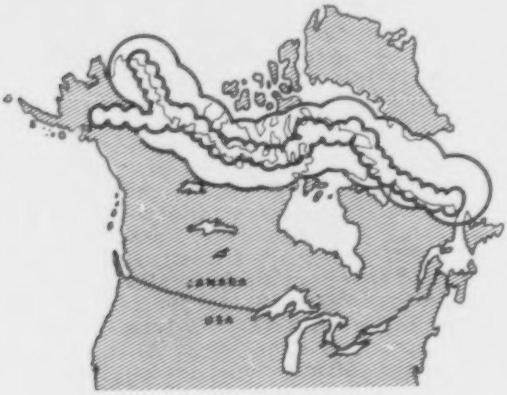
a. MISSION: The Over-the-Horizon Backscatter (OTH-B) radar will provide tactical early warning of an attack on North America by bombers and air-to-surface missiles through long-range, all-altitude, wide-area surveillance of the coastal approaches to North America. It increases warning time for survival of the strategic retaliatory forces and provides decision time for the National Command Authority consistent with ballistic missile warning requirements.

b. STATUS: The Air Force plans to deploy four OTH-B radar systems. The East Coast system will provide surveillance of the Atlantic from the Labrador coast (where it links to the Distant Early Warning line replacement, the North Warning System) to Florida. The initial sector of the East Coast radar system will be delivered to the Air Force in Fiscal Year 1987. The remaining two sectors will be delivered in Fiscal Year 1987. The West Coast radar system will provide surveillance of the Pacific Ocean area from Alaska to Mexico. Procurement of the West Coast system will occur in Fiscal Years 1986 and 1987. The Central system is the third system and will link the East and West OTH-B radar systems. It will provide surveillance of the southern approaches to the United States and will cover Atlantic and Pacific Ocean areas inside the 500 mile minimum range of the East and West Coast systems. Deployment is scheduled in the early 1990s. The Alaskan system will provide air surveillance of the Aleutian Islands. The system will also be deployed in the early 1990s.



*OVER-THE-HORIZON BACKSCATTER RADAR*

7. North Warning System



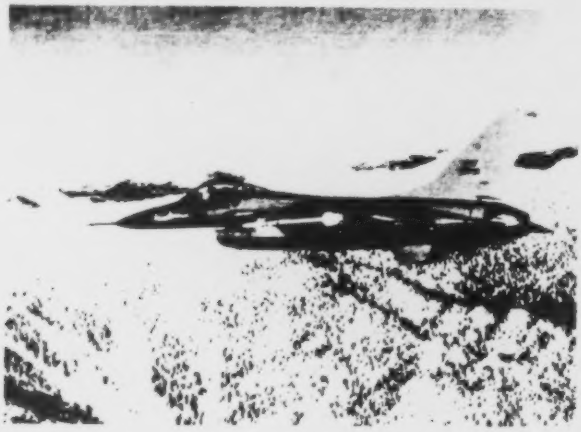
*NORTH WARNING SYSTEM*

a. MISSION: The North Warning System (NWS) program replaces the line of Distant Early Warning (DEW) radar stations. The 31 existing DEW line radars are old, expensive to operate and maintain, and deficient in coverage and radar performance. The NWS will provide credible long-range all-altitude coverage to complement OTH-B surveillance. Its mission is to provide reliable, timely northern tactical warning of a bomber or cruise missile attack on North America. This warning provides the National Command Authority time for decisionmaking and time to initiate strategic forces and strategic command, control, and communications survival actions.

b. STATUS: The North Warning System will consist of a total of 52 radar stations: thirteen long-range, minimally-attended radars and 39 short-range, unattended radars. Upgraded communications to interconnect the radar stations and transmit data to the Joint Surveillance System Region Operation Control Centers will be provided as part of the new program. Development of the new short-range radar began in 1984, while production of the long-range radar is continuing. Field deployment and site construction status in terms of capability/fielded systems are being done under a new joint venture with Canada. In Fiscal Year 1987, communications upgrades and development of the short-range radar stations will continue. Both the long- and short-Range radars will provide a capability to detect and track cruis missiles and improve supportability.

8. Air Interceptor Force Modernization

a. MISSION: The strategic air defense interceptor force consists of 14 squadrons (three active and eleven Air National Guard) tasked to maintain aircraft on alert at U.S. airfields. The interceptors primary mission in peacetime is to intercept and identify unknown aircraft approaching North American airspace. During wartime they can also provide a limited defense against bombers and cruise missiles. The Airborne Warning and Control System will be used to ensure survivable surveillance and to meet command and control requirements for the interceptors.



*F-16 FIGHTING FALCON*

b. STATUS: To ensure that we are obtaining the most effective interceptor force at the lowest cost, we are holding a competition among an F-16 the commercially developed F-20, and other suitable aircraft. The one time, full and open competition, will be a winner-take-all for approximately 300 aircraft with a planned production start in Fiscal Year 1987.

*F-20 TIGERSHARK*

## C. Space Surveillance and Defense

### BACKGROUND

1. Rationale: The second area of concern in Strategic Defense is Space Surveillance and Defense. Space Surveillance is a NORAD, multi-service, multi-national responsibility. Space Defense is a U.S. SPACECOM mission only. The demonstrated Soviet threat in space both offensively and in support of land forces requires a robust space surveillance and defense capability.

2. Threat: The Soviets continue to pursue a dynamic and expanding military space program, including an operational antisatellite system and reconnaissance systems. Our current capability to monitor events in space is accomplished entirely with a ground-based system of radars and electro-optical sensors. Current command and control functions provided by the North American Aerospace Defense Command Operations Center are essentially manual and require improvements to support timely coordinated responses to potential military conflicts including threats to our space assets.

3. Current Systems: Our current space surveillance system, SPACETRACK, is composed of three Ground-based Electro-Optical Deep Space Surveillance stations and a number of dedicated and contributing radar stations. These systems are currently limited by line-of-sight. Against the present

and projected future threats these systems must be upgraded to provide improved low-altitude coverage, high-altitude detection and tracking, and an ability to report space events in a timely manner.

4. Future Systems: For the far term, our space surveillance advanced development efforts are meshed with the President's Strategic Defense Initiative (SDI). The Air Force goal is to deploy by the mid-1990's, a survivable space surveillance and tracking system which will provide full earth orbit coverage, reduce dependence on overseas basing of sensors and provide timely, operationally responsive coverage of objects and events in space. The Air Force surveillance requirements are incorporated into the SDI technologies development plan. When the technology has matured in the SDI program, it will be transferred to the Air Force, and a system will be developed and deployed.

## Fiscal Year 1987 PROGRAMS

### 5. SPACETRACK

a. MISSION: The SPACETRACK program provides us with the ability to monitor space objects and space activities. This surveillance capability is key to giving the National Command Authorities adequate warning time for development of defensive options at all levels of conflict as well as increased survivability of our space assets.

b. STATUS: In Fiscal Year 1987 we will complete installation of a Ground-based Electro-Optical Deep Space Surveillance (GEODSS) station at Diego Garcia. This site will be operational in Fiscal Year 1987. Another GEODSS site is planned for Portugal; it will be operational in Fiscal Year 1988. We also plan several other improvements to the SPACETRACK system: installation of a central Pacific Barrier radar, refurbishment of existing radar sensors, improvements to radar calibration techniques, and real-time reporting of SPACETRACK data.

### 6. Space Defense Systems

a. MISSION: The Space Defense program continues development of a low-altitude miniature vehicle antisatellite (ASAT) system. The primary purposes of an ASAT capability are to deter threats to space systems of the United States and its Allies, and within such limits imposed by international law, to deny any adversary the use of space-based systems that support hostile military forces.

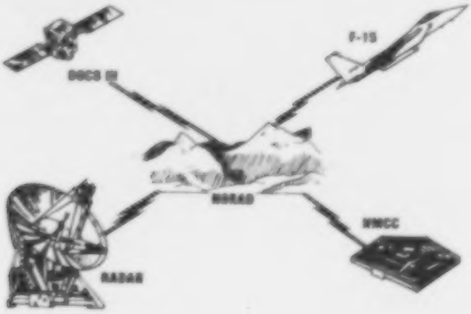
b. STATUS: On September 13, 1985 the ASAT system was successfully tested against a resident space object. The test was flawless. Fiscal Year 1986 Public Law prohibits us from testing the ASAT against an object in space until the President certifies that the Soviets have conducted a test of their dedicated ASAT. We have restructured our Fiscal Year 1986 test program to comply with the law. In Fiscal Year 1987 we will continue to test the ASAT missile and continue the production verification program.

**ASAT LAUNCH PICTURE**

*ASAT LAUNCHED FROM F-15*

7. Space Defense Command and Control System

a. MISSION: A Space Defense Command and Control System is needed to satisfy the Presidential directive to improve, in a balanced manner, our space defense capability. Current space defense operations lack real-time response and cannot satisfy new operational requirements. This program is a phased approach supporting effective integration, coordination and management of our evolving space defense resources.

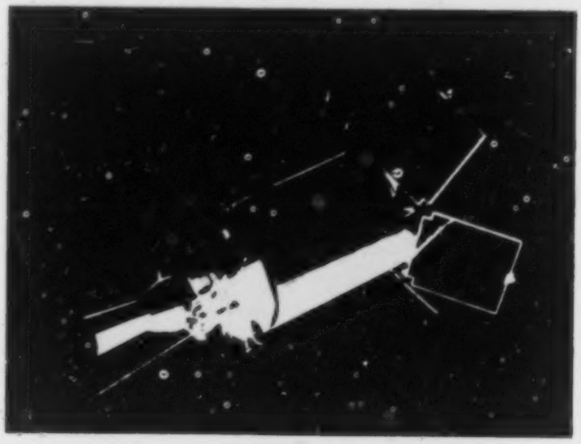


*SPACE DEFENSE OPERATIONS CONTROL CENTER*

b. STATUS: In Fiscal Year 1987, phased design and development activities in support of the Space Defense Operations Control Center will continue. Upgrades in support of our space surveillance and space defense activities include increased space object cataloging capability to satisfy the processing speed and increased data requirements imposed by the worldwide use of space; semi-automated space warning, counter measure management, evasive maneuver detection, and strike assessment.

8. Defense Support Program

a. MISSION: The Defense Support Program (DSP) is a key element of our nation's strategic defensive posture. This program provides data to the National Command Authority, North American Aerospace Defense Command, and Strategic Air Command. Our development efforts are aimed at increasing the survivability of operational data through design of ground station modifications. These stations will be made compatible with the survivability improvements of follow-on satellites.



*DSP ON ORBIT WITH LASER CROSSLINK*

b. STATUS: To meet near term requirements, four DSP satellites were procured: two in Fiscal Year 1983 and two in Fiscal Year 1984. In Fiscal Year 1986, we will take delivery of the first of these satellites; continue ground station compatibility modifications, and complete testing on all mobile ground terminals. Multiyear procurement of the next block buy of satellites is planned for Fiscal Year 1987. Fiscal Year 1987 will also see continued research and development with primary emphasis aimed at minimizing/eliminating operational employment deficiencies and vulnerabilities; the development of a more survivable DSP system through upgrades to the Mobile Ground System and satellites, and ensuring adequacy of ground station data processing capabilities.

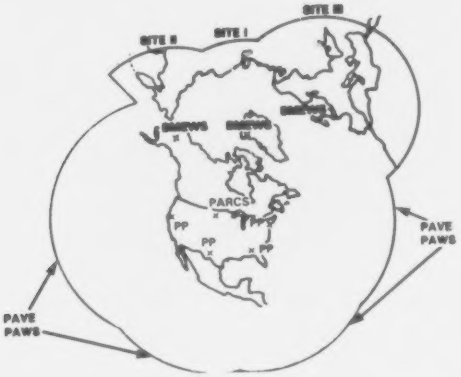
## D. Ballistic Missile Warning and Attack Assessment

### BACKGROUND

1. Rationale: The third area of Strategic Defense is the ballistic missile area. Management of the ballistic missile tactical warning and attack assessment as an integrated system is necessary to ensure accurate, timely and unambiguous warning, and assessment information to support force survivability and national decisionmaking. These systems provide warning of missiles launched from all fixed-site Soviet intercontinental ballistic missile launch areas and areas historically patrolled by ballistic missile submarines in the northern hemisphere.

2. Threat: Soviet ballistic missile capabilities have improved to the point that we must upgrade our existing BMEWS radars and deploy new Submarine-Launched Ballistic Missile (SLBM) warning systems to ensure adequate coverage and meet the modern, multiple reentry vehicle long-range threat.

3. Current Systems: A network of sensors provide our National Command Authorities with ballistic missile attack warning and assessment. These sensors include space satellite systems; Ballistic Missile Early Warning System sites in Alaska, Greenland, and the United Kingdom; the Perimeter Acquisition Radar Characterization System (PARCS) radar in North Dakota; SLBM detection and warning sites (PAVE PAWS) in Massachusetts and California, and the AN/FPS-85 and AN/FSS-7 SLBM detection radars in Florida.



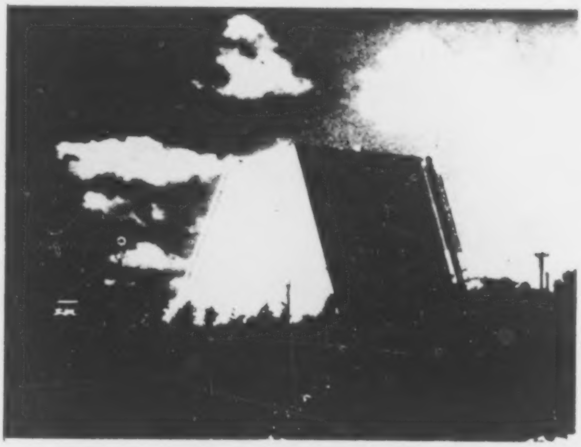
*PLANNED BALLISTIC MISSILE SURVEILLANCE SYSTEM*

4. Future Systems: PAVE PAWS and BMEWS will continue to provide the primary ballistic missile warning network for the United States. Planned upgrades are discussed in the following section.

## Fiscal Year 1987 PROGRAMS

### 5. PAVE PAWS

a. MISSION: This phased-array radar program is part of the national system for tactical warning and attack assessment of SLBMs. As a complement to our satellite warning systems, it provides confirmation of launch information to the National Command Authorities.



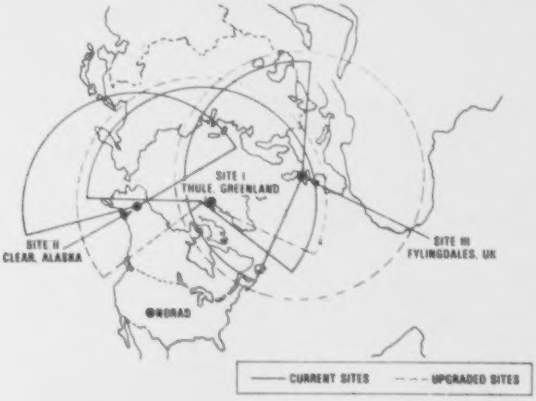
*PAVE PAWS*

b. STATUS: To accommodate the increased Soviet SLBM threat, two new PAVE PAWS radars are now under construction in the southeastern and southwestern United States. When these sites become operational in Fiscal Year 1987, they will join the existing Northeast and Northwest PAVE PAWS radars and the Perimeter Acquisition Radar Characterization System in North Dakota to form a five-site phased-array SLBM radar-warning network. This network will provide 360 degrees of warning coverage around the United States, and also allow us to close the older, less capable operationally expensive AN/FPS-85, and AN/FSS-7 SLBM radars currently in use.

In Fiscal Year 1987, efforts will continue to complete the basic PAVE PAWS radars at Robins Air Force Base, Georgia and Goodfellow Air Force Base, Texas. Warning capability improvements will also be added to the Robins Air Force Base radar and to existing PAVE PAWS radars at Otis Air National Guard Base, Massachusetts and Beale Air Force Base, California.

6. Ballistic Missile Early Warning System

a. MISSION: The mission of the Ballistic Missile Early Warning System (BMEWS) is to detect and provide warning of a ballistic missile attack on the United States, Canada, the United Kingdom, and Europe. BMEWS is part of the national system for Tactical Warning and Attack Assessment.



*BALLISTIC MISSILE EARLY WARNING SYSTEM*

b. STATUS: The BMEWS modernization program is replacing existing 20-year old conventional radars at the Thule Air Base, Greenland site with a new solid-state phased-array radar. The new system will become operational in late 1986. This will improve system performance and capacity and provide better pre-impact assessment. In Fiscal Year 1986, we will also begin a similar modernization program at the Fylingdales, England site. In Fiscal Year 1987 upgrade of the Thule site will be completed and an initial operational capability achieved. Software development, system engineering and equipment fabrication will continue on the Fylingdales upgrade effort.

## E. Strategic Defense Initiative

1. Rationale: President Reagan's Strategic Defense Initiative (SDI) challenged the scientific community to determine the feasibility of developing systems capable of destroying ballistic missiles in flight, thus providing an alternative to our sole reliance on offensive nuclear retaliation as the basis for strategic deterrence and leading to the ultimate goal of eliminating the threat of ballistic missiles. Following the President's March 1983 SDI speech, the DoD initiated the Defense Technologies Study to define a long-term research and development program. The purpose of this program is to explore the key technologies needed for an effective multitiered ballistic missile defense. The goal of the research program is to develop a base of proven technology that can lead to a defensive system that will destroy Soviet ballistic missiles during the boost, post-boost, midcourse, and terminal phases of flight. In the long run, SDI is intended to

be the crucial means by which the United States and the Soviet Union can safely agree to deep reductions and eventual elimination of ballistic missiles.

2. Current Systems: To carry out the President's long-term research and advanced technology program, DoD created a new defense agency in April 1983, the Strategic Defense Initiative Organization (SDIO). The initiative focuses on technology development in five areas: surveillance, acquisition, tracking and kill assessment, kinetic energy weapons, directed energy weapons, battle management/command, control, communications ($C^3$) and system analysis, and supporting technologies (lethality, survivability, space prime power, and space logistics).

The overall management of SDI is characterized by centralized planning and control with decentralized execution by the Army, Air Force, Navy, Defense Advanced Research Projects Agency, Defense Nuclear Agency and Department of Energy. The Air Force executes approximately 30-35% of the SDI program in the 1985 - 1990 timeframe. Air Force Systems Command through its laboratories and two major product divisions, Electronic Systems Division and Space Division award and manage the programs.

***STRATEGIC DEFENSE INITIATIVE***
***Artist's Concept***

3. Future Systems: Several ongoing Air Force programs have been integrated into SDI. The most notable are the Advanced Warning System (now Boost Surveillance and Tracking System), the Space-Based Space Surveillance System (now Space Surveillance and Tracking System), and the Strategic Laser Technology

Program (now part of Directed Energy Weapons). These programs are conducted under SDI in order to meet the broader range of requirements involving ballistic missile defense as well as meeting the currently validated tactical warning/attack assessment and space defense. We are also heavily involved in the Battle Management and $C^3$ and Supporting Technologies Program. During the 1980s, we will pursue experiments and demonstrations assessing the feasibility of application technologies in support of 1990s development decisions. By pursuing a vigorous research and development program consistent with the Anti-Ballistic Missile Treaty, the United States can be in a position in the early 1990s to make an informed decision to enter full scale development of selected candidate systems. Development of these systems may potentially lead to an effective defense against ballistic missiles for the U.S. and our allies.

STRATEGIC AIR COMMAND
COMMAND POST
OFFUTT AFB, NEBRASKA

DEPARTMENT OF THE AIR FORCE
MCMXLVII
UNITED STATES OF AMERICA

# VI. STRATEGIC COMMAND, CONTROL, COMMUNICATIONS

## A. Objectivies

The capability of the U.S. nuclear forces to deter attack depends upon the Soviet's perception of their own capability to successfully launch a first strike. Through our strategic Command, Control, Communications ($C^3$) systems, we report events that are critical to the survival of strategic forces. Strategic $C^3$ systems provide the link between the National Command Authority and the Joint Chiefs of Staff, through the Unified and Specified Commands, to U.S. nuclear retaliatory forces.

## B. Command, Control, Communications

### BACKGROUND

1. Rationale: The National Command Authorities must be provided critical information about a Soviet nuclear first strike to assure timely and direct execution of our national policies and defensive strategy. Strategic $C^3$ systems link our attack warning and defensive forces and our strategic retaliatory forces to the command centers and to each other. Strategic $C^3$ systems must be reliable and effective throughout the entire spectrum of conflict.

2. Soviet Threat: Threats to our $C^3$ systems include sabotage, physical attack, jamming, and effects of electromagnetic pulse.

3. Current System: Our strategic $C^3$ systems are composed of fixed and mobile command centers and ground, airborne and space communications platforms. Included are the National Emergency Airborne Command Post, Cheyenne Mountain Complex, Post Attack Command and Control System, Strategic Air Command Automated Command and Control System, and the Air Force Satellite Communications system. Some of these systems are becoming increasingly expensive to operate and maintain.

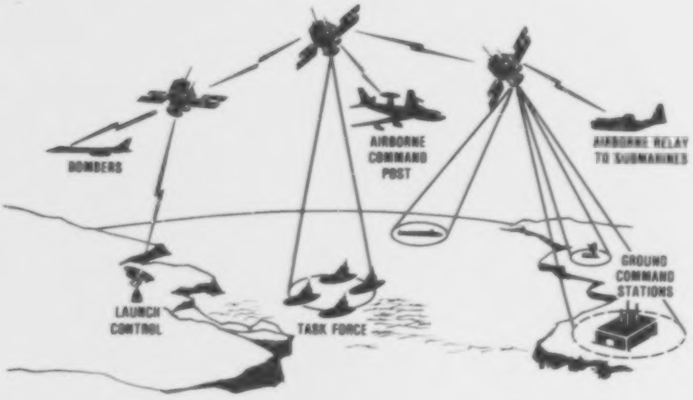
4. Future Systems: Due to its importance to deterrence, the upgrade of the U.S. strategic $C^3$ systems was made the first priority of the President's strategic modernization program. Although no one system can achieve all the desired characteristics to meet the current and projected threat, a proper mix of ground-based and satellite systems, along with redundancy of critical $C^3$ nodes, will provide high confidence that our strategic $C^3$ systems would survive and endure through the trans- and post-attack periods.

## STRATEGIC COMMAND, CONTROL, COMMUNICATIONS

### Fiscal Year 1987 PROGRAMS

5. Milstar

a. MISSION: Milstar will provide worldwide, two-way, secure, highly jam-resistant, survivable, and enduring voice/data communications for the National Command Authorities. This multi-service system will enable the President and the Commanders-in-Chief to direct strategic and tactical forces through all levels of conventional and nuclear conflicts. Milstar is a pivotal part of the President's strategic modernization program and has been designated as a program of the highest national priority.



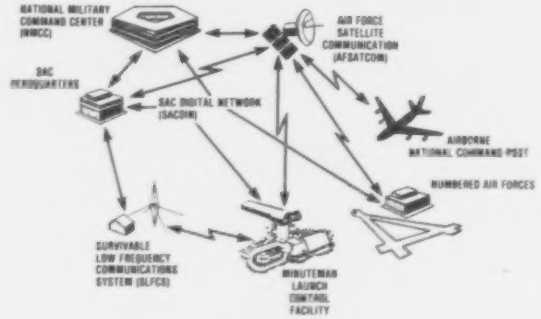
*MILSTAR*

b. STATUS: Currently the Air Force depends on the Air Force Satellite Communications system for long-range strategic communications. This ultra-high frequency system has limited jam resistance and physical survivability. Milstar will operate at extremely high frequency (EHF) and will provide a much more survivable and enduring communications capability while significantly increasing the number of available communications channels. The Air Force is responsible for the satellite which is now in its detailed design phase. The Navy and Army are responsible for seagoing and most ground satellite communications terminals, respectively. The Navy and Army are expected to enter full scale development contracts in Fiscal Year 1986. The Air Force is responsible for all airborne and some ground terminals. The Air Force terminal program began its last stage of development in June 1985 which will result in terminals for qualification and testing in Fiscal Year 1987. The Milstar system is in full scale development.

## STRATEGIC COMMAND, CONTROL, COMMUNICATIONS

### 6. Strategic Air Command Digital Network

a. **MISSION**: Strategic Air Command Digital Network (SACDIN) will replace the data transmission subsystem of the Strategic Air Command Automated Command and Control System (SACCS). The present data transmission subsystem of SACCS is based on 1950's technology and is becoming very difficult to maintain. Improvements include automated communications processors, linked together initially by a dedicated line network, and in the 1990 timeframe by the common user Defense Data Network, to meet SAC's requirements for high-speed message delivery. SACDIN will provide rapid, secure transmission of emergency action messages and status reports of SAC's aircraft and missile forces.


NATIONAL MILITARY COMMAND CENTER (NMCC)
AIR FORCE SATELLITE COMMUNICATION (AFSATCOM)
SAC HEADQUARTERS
SAC DIGITAL NETWORK (SACDIN)
AIRBORNE NATIONAL COMMAND POST
NUMBERED AIR FORCES
SURVIVABLE LOW FREQUENCY COMMUNICATIONS SYSTEM (SLFCS)
MINUTEMAN LAUNCH CONTROL FACILITY

*STRATEGIC AIR COMMAND DIGITAL NETWORK*

b. **STATUS**: Production and fielding of SACDIN communications processors began in Fiscal Year 1985. Total production will include 135 terminals. Full operational capability is scheduled for late Fiscal Year 1987.

### 7. Aircraft Alerting Communications Electromagnetic Pulse Upgrade

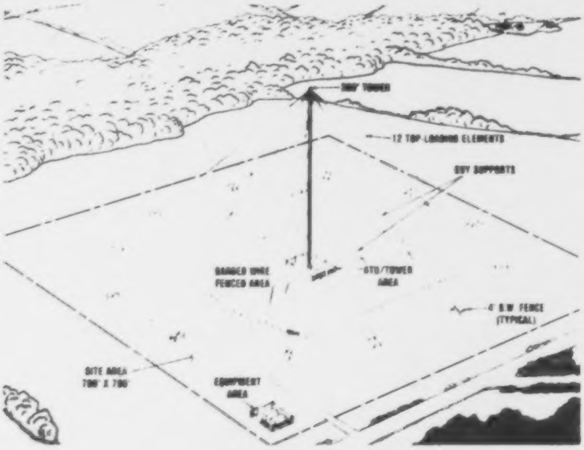
a. **MISSION**: The Aircraft Alerting Communications Electromagnetic Pulse (AACE) upgrade will provide shielded enclosures, electromagnetic pulse (EMP) hardened consoles, and EMP hardened power supplies for selected electronic equipment at SAC command posts supporting aircraft operations. The AACE upgrade will also provide EMP event detectors at each command post.

b. **STATUS**: In Fiscal Year 1986 initial operational tests and evaluations will be completed and the first of 24 AACE production units will be delivered. Deliveries and installations will continue through Fiscal Year 1987 at a rate of approximately one base per month. Installations will be completed by Fiscal Year 1989.

## STRATEGIC COMMAND, CONTROL, COMMUNICATIONS

### 8. Ground Wave Emergency Network

a. MISSION: The Ground Wave Emergency Network (GWEN) is a part of the President's strategic modernization program and will provide assured communications between the national command authority, major command centers, missile warning sites, and U.S. based nuclear forces. Assured communications are essential to reduce the temptation for a preemptive first strike on the United States. Survivable communications are provided through a network of radio relay stations that interconnect user terminals at those locations.



*GWEN TOWER*
*Artist's Concept*

b. STATUS: Full scale development of the prototype network, including relay stations, input and output ground and airborne terminals, and receive-only terminals, began in Fiscal Year 1983 and will continue into Fiscal Year 1986. During Fiscal Year 1986, prototype network testing will be concluded. In Fiscal Year 1986, we will conduct initial operational test and evaluation of the GWEN network. In Fiscal Year 1987 we will continue missile and airborne terminal prototyping and begin development of portable receive only terminals. We will also begin production and installation of the relay node stations. Full operational capability is planned for Fiscal Year 1990.

### 9. Minimum Essential Emergency Communications Network

a. MISSION: The Minimum Essential Emergency Communications Network (MEECN) system ensures delivery of critical messages under stressed conditions. Current projects will upgrade or provide new equipment required for improved dissemination of emergency action messages through long-range survivable, secure data communications.

b. STATUS: We will continue in Fiscal Year 1986 the development of diversity reception equipment for deployment aboard worldwide airborne command post aircraft and at selected ground sites. This new equipment will upgrade and replace existing very low frequency/low frequency transmist application. Communication range, message accuracy, and transmission time will be greatly improved. Also, development will continue for the very low frequency/low frequency miniature receive terminals for bomber aircraft. These receive terminals will provide a new communications link for bombers that will be unaffected by atmospheric disturbances. In Fiscal Year 1987 full scale development will continue and flight testing will begin on the miniature receiver terminals. Full scale improvements to a higher power transmitter/dual wire antenna system will begin and improvements to our current Survivable Low Frequency Communication System will continue.

### 10. Worldwide Airborne Command Post

a. MISSION: The EC-135 airborne command post provides an airborne operations center for survivable command and control of our nuclear forces. These aircraft, along with E-4B National Emergency Airborne Command Post aircraft, form the basis of the Worldwide Airborne Command Post system.

*E-4B NATIONAL EMERGENCY AIRBORNE COMMAND POST*

b. STATUS: With the increasing age of the EC-135 Post Attack Command and Control System aircraft and the national emphasis on strategic communications capabilities, the Air Force has developed plans to modernize these aircraft. Additionally, we are currently conducting trade studies and preparing an acquisition plan for phasing in a replacement system. Major modifications are planned for the EC-135 aircraft in Fiscal Year 1987. These modifications include continuing the ultra-high frequency/frequency division multiplex replacement, the initial Milstar transition satellite communications terminals and the Peacekeeper upgrades to Airborne Launch Control Center aircraft. Other enhancements to be programmed in subsequent years include the full Milstar capability, Ground Wave Emergency Network terminals, improved low frequency/very low frequency radios and antennas, and installation of the Nuclear Detonation Detection System terminals. Also in Fiscal Year 1987, we will begin installation of several classified communications systems for the E-4B command post aircraft. The E-4B will receive the initial Milstar modification as well as Nuclear Detonation Detection System terminals, Ground Wave Emergency Network terminals, and the improved low frequency/very low frequency equipment.

### 11. Defense Satellite Communications System

a. MISSION: Defense Satellite Communications System (DSCS) provides super high frequency satellite communications for secure voice and high data rate transmissions to support both defense and diplomatic users.

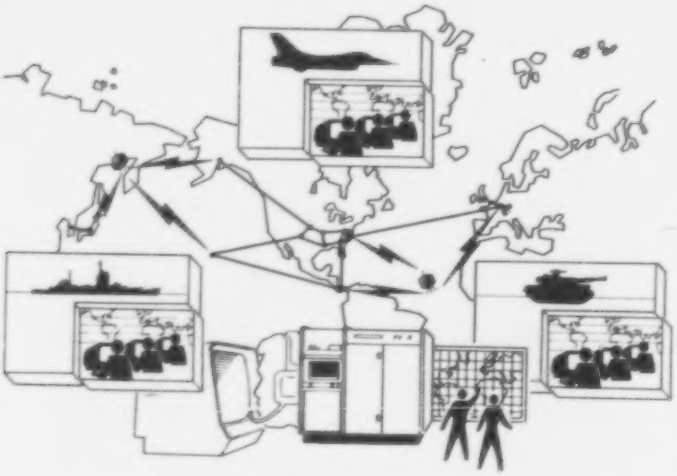
b. STATUS: In Fiscal Year 1984 we initiated an expanded advance buy of parts for seven DSCS III satellites. In Fiscal Year 1985 we received authority to increase the scope of this contract to a full multiyear production contract. The Fiscal Year 1986 and 1987 budget requests provide funding for two satellites each year, and continues advance procurement for the remaining vehicles.

*DSCS III ON ORBIT*

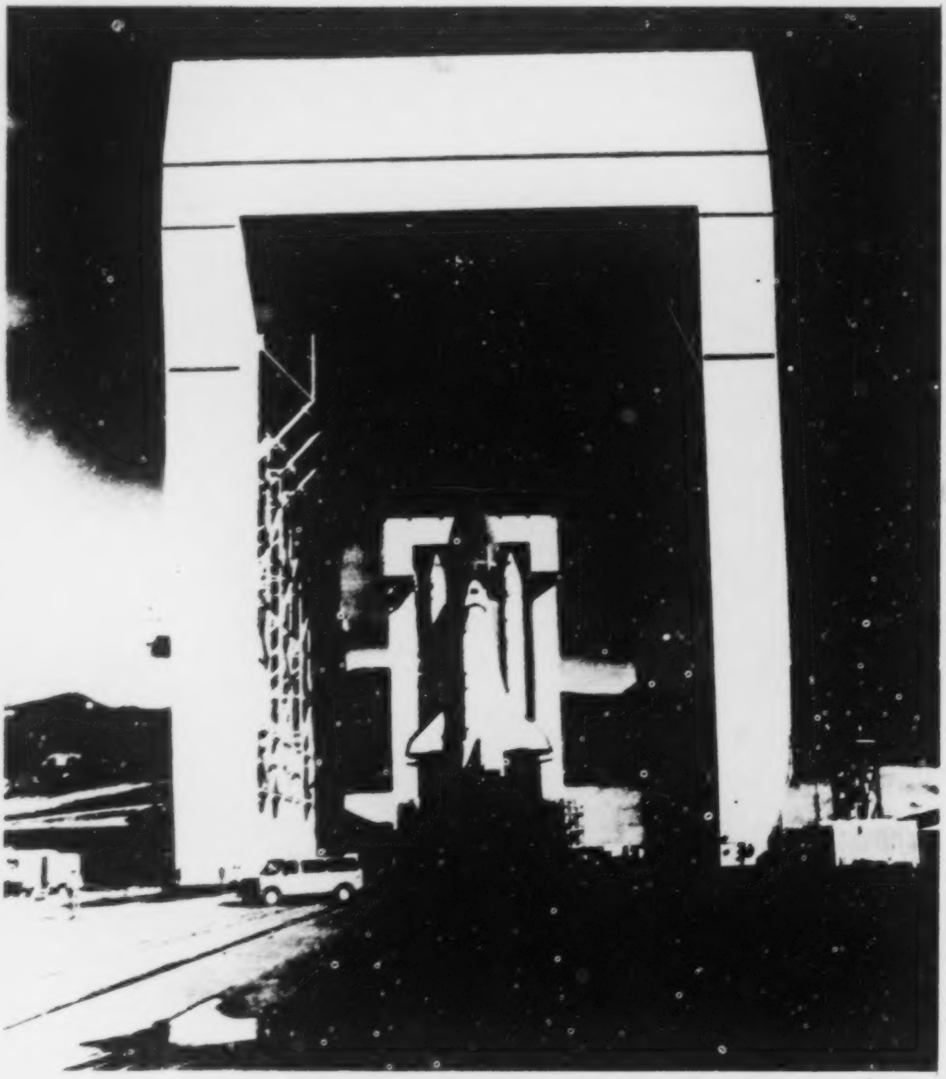
### 12. WWMCCS Information System

a. MISSION: The WWMCCS Information System (WIS) modernizes the Worldwide Military Command and Control System (WWMCCS) standard automatic data processing hardware and software. WIS-provided automated command and control ($C^2$) support for the National Command Authorities, the Joint Chiefs of Staff, the Unified/Specified/Component Commanders, and the Service headquarters will be used to plan, execute and monitor the mobilization, deployment, employment and sustainment of U.S. Forces worldwide. The evolutionary program will deploy three blocks of capability: (1) Block A provides a transition architecture and automated message handling, (2) Block B provides modern, flexible, database-supported software, host computers and implements the transition to the modernized joint operations software, and (3) Block C provides additional $C^2$ software capabilities not deployed as part of Block B.

b. STATUS: Block A local area network and automated message handling full scale development, integration and development testing will continue through Fiscal Year 1987. Following operational test and evaluation in Fiscal Year 1988, Block A capability will be deployed and an initial operational capability will be achieved. Prototype development of joint mission software (Block B) is planned for Fiscal Year 1987. Full scale design and development will continue into Fiscal Year 1988. The Joint Mission Hardware Contract is planned for award in Fiscal Year 1987, also. WIS research, development and test is funded by the Army, Navy and Air Force. The Air Force has the lead in development and acquisition.



*WWMCCS INFORMATION SYSTEM*



SPACE SHUTTLE AT VANDENBERG LAUNCH SITE

# VII. SPACE OPERATIONS

## A. Objectives

The Air Force objectives in space include: pursuing a vigorous research and development program to give us future options in space; providing an expendable launch vehicle to complement the Shuttle for assured access to space; improving the reliability, maintainability, and supportability of our space assets; achieving an operational antisatellite capability compatible with the President's pledge to seek the strictest possible agreement, which is both verifiable and in the national security interests, and continuing to exploit the unique attributes of the Space Shuttle as they relate to military applications in space.

## B. Space Launch and Operations

### BACKGROUND

1. Rationale: In order to maintain our national security, DOD acquires and operates space systems and pursues advances in related research and technology development. Our current space systems support a variety of functions, such as communications, tactical warning and attack assessment, arms control verification, weather and space defense. The global access capability of our satellites coupled with their efficiency in terms of mission and cost, reflect our primary reasons for space activities.

2. Soviet Threat: The Soviets have long known the military utility of operating in space and have committed significant resources toward a sizable space presence. The Soviet space program is under control of the military establishment. Moreover, the Soviets have spent great sums to develop a robust space presence that supports specific military and political objectives and provides options for space initiatives that could significantly modify their strategic posture in relation to the U.S. The Soviets today have the only operational antisatellite weapon and continue to develop the most extensive and flexible launch capability in the world.

3. Current Systems: The Space Transportation System (STS) is the national program for providing U.S. Government and commercial users, as well as foreign users, routine access to space. The STS consists of the Space Shuttle, upper stages, and Spacelab. The National Aeronautics and Space Administration (NASA) is responsible for developing and operating the Shuttle.

A continuing need exists to provide a highly reliable means of placing critical Department of Defense satellites into their required mission orbits. Providing this assured access to space will be accomplished through the use of the existing and planned expendable launch vehicles such as the Titan II, Titan III, Atlas E, the STS, and the Complementary Expendable Launch Vehicle system.

## SPACE OPERATIONS

*SPACE SHUTTLE*

4. Future Systems: Our plans for space include: making our space systems (the satellites, the ground stations, and the communications links between them) more survivable from attack; improving the surveillance, communications and navigation capabilities of our space systems, and increasing the robustness of our space system network by removing single nodes, procuring backup satellites, and reducing our dependency on overseas ground stations.

Additionally, we are concentrating our efforts on doing more with each launch by deploying satellites with the capabiltiy to perform multiple missions and with much longer operational life. To optimize our deployment and on-orbit performance, we are evaluating alternate space launch capabilities, improving our space operations capabilities, and aggressively pursuing advanced space related technology.

5. New Space Command: In July 1982, the President issued a new National Space Policy directing a balanced civil and national security space program. As part of the national security space program, the Air Force established the Air Force Space Command, a new major command to centralize and manage our operational space activities. In September 1985, the new unified command, U.S. Space Command, with participation of all four armed services, was activated.

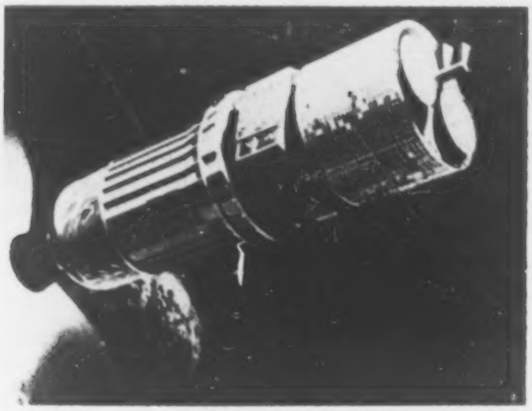
### Fiscal Year 1987 Programs

6. Space Shuttle Operations

a. MISSION: The Air Force is the Department of Defense executive agent for military applications of the Space Shuttle. In this role, the Air Force is responsible for acquiring and operating the Space Shuttle launch site at Vandenberg Air Force Base. Additionally, this program provides the upper stages needed to place DOD payloads from low earth orbit (LEO) to geosynchronous orbit (GEO). To accomplish this orbital transition we are procuring the Inertial Upper Stage (IUS), Centaur G Upper Stage, and the Payload Assist Module-Delta Class II (PAM-D II).

*VANDENBERG LAUNCH SITE*

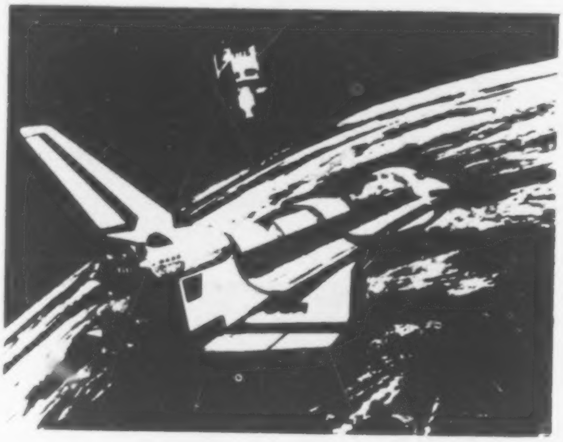
b. STATUS: The Vandenberg launch facility was officially activated on October 1, 1985. Pending the findings of the President's Space Shuttle Commission, the Orbiter Discovery is currently scheduled for launch in July 1986. The payloads are the Space Test Program's Teal Ruby experiment - a new infrared mosaic sensor that can detect and track aircraft, and Cryogenic Infrared Radiance Instrumentation For Shuttle - a Shuttle bay experiment to collect data on the aurora and earth atmosphere. The launch of Discovery opens up a new era in our manned spaceflight capabilities in that we will now be able to operate in and deliver payloads to, near-polar, retrograde-azimuth as well as equatorial orbits. This will also be the first shuttle launch to take place from secure Air Force facilities and under control of the Space and Missile Test Organization of Air Force Systems Command's Space Division.



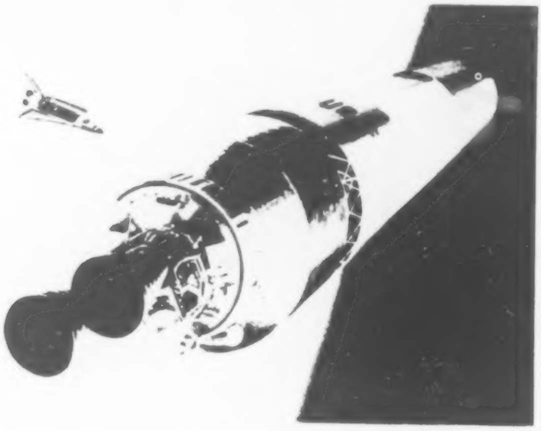
*IUS LAUNCHING A DSCS II*

## SPACE OPERATIONS

In Fiscal Year 1987, procurement funds are required to continue the PAM-D II multiyear procurement in support of the Navstar Global Positioning System (GPS) program. Funds will be used to provide logistics support for the IUS and Vandenberg launch site.



*PAM-D II LAUNCHING GPS FROM SPACE SHUTTLE*

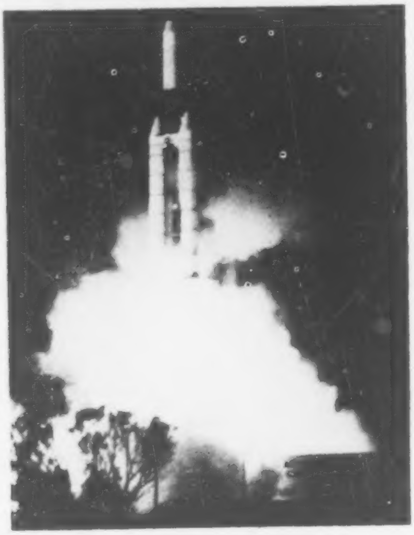


*CENTAUR G*

Also in Fiscal Year 1987 the Air Force will continue funding for the Centaur G vehicles initiated in Fiscal Year 1985 and acquire two additional Centaurs in support of the Milstar program. These two additional vehicles will be incrementally funded and used to launch Milstar research and development satellites. Finally, our Fiscal Year 1987 request will fund the Manned Spacecraft Engineer program and the orbiter flight charge reimbursements to NASA.

### 7. Space Boosters

a. MISSION: Under the Space Boosters Expendable Launch Vehicle (ELV) program, we currently launch Titan 34Ds and refurbish and launch Atlas E ELVs. Our last Titan 34D is scheduled for launch in Fiscal Year 1988 and the last Atlas E will launch a Defense Meteorological Satellite in Fiscal Year 1990. This program provides for the procurement, engineering support and flight performance assessment of our expendable launch vehicles. It also provides resources for the Titan 34D Transtage launches at the Eastern Test Range, and for the Atlas E launches of satellites from the Western Test Range



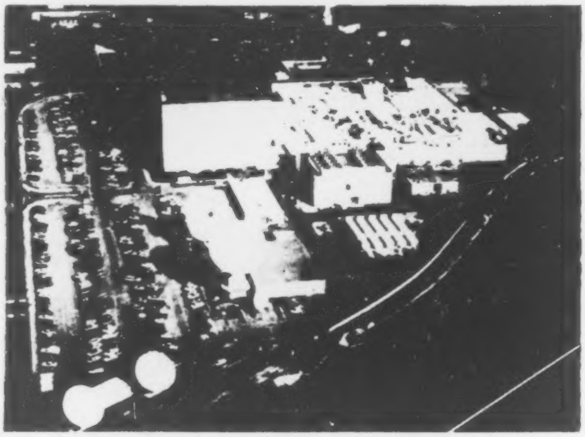
*TITAN 34D*

b. STATUS: We began in Fiscal Year 1985 and will continue through Fiscal Year 1987 to upgrade the Titan 34D to be capable of launching Shuttle-sized satellites. We initiated production program for ten ELVs in Fiscal Year 1986 with an initial launch capability scheduled for Fiscal Year 1989. Furthermore, in Fiscal Year 1986, we began development efforts to convert the deactivated Titan

II Intercontinental Ballistic Missiles into a space vehicle configuration to launch a limited number of smaller satellites.

### 8. Satellite Control Facility

a. MISSION: The Air Force provides on-orbit control for Department of Defense satellites from the Satellite Test Center at Sunnyvale Air Force Station, California. It is a global network of instrumentation systems, antennas, communications and data processing equipment required to support the growing inventory of increasingly complex space vehicles.



*SATELLITE CONTROL FACILITY*
*SUNNYVALE CALIFORNIA AIR FORCE SATION*

b. STATUS: The current computer system in the Satellite Control Facility (SCF) is costly to maintain and becoming logistically unsupportable. Furthermore, it is incapable of supporting new, more sophisticated satellites now in development. In Fiscal Year 1987, we will continue development and acquisition of the SCF Data System Modernization program, which will correct operational limitations and form the core configuration for operations at both the SCF and the Consolidated Space Operations Center (CSOC). As the CSOC is developed, the data systems modernization computers will be installed there to provide internetting with the SCF. Data System Modernization will reach initial operational capability in Fiscal Year 1986 and Full Operational Capability in the SCF in September 1987. Fiscal Year 1987 funds will also continue development and acquisition of the Advanced Remote Tracking Station to replace and refurbish the existing remote tracking stations to complement the Data System Modernization system.

### 9. Consolidated Space Operations Center

a. MISSION: The Consolidated Space Operations Center (CSOC) combines two major missions for the Department of Defense: satellite control and

Shuttle military operations. The CSOC Satellite Operations Complex (SOC) will plan and execute operational control of operational DoD satellites. The Shuttle Operations and Planning Complex (SOPC) will provide limited Shuttle flight planning and readiness support and conduct Shuttle mission operations for DoD flights.

The SCF is DOD's single existing satellite control center and as such, constitutes a potential single point failure for satellite control and is vulnerable to both environmental and man-made threats. The addition of the SOC will greatly increase mission capability, flexibility and survivability by providing mutual emergency back-up for mission essential functions.

The SOPC will provide for planning, control, and enhanced security of DoD Shuttle missions. Until the complex becomes operational, DoD missions will be performed totally by NASA's Shuttle control faciliity at Johnson Space Center (JSC) in Houston, Texas. Once operational, JSC will share the planning, readiness, and control workload for Shuttle flights as well as provide emergency back-up capability for SOPC.

b. STATUS: The CSOC buildup and other site facilities were completed in September 1985 and were turned over from the Army Corps of Engineers to Space Command. The SOC is schedule to achieve its Initial Operational Capability (IOC) in February 1987. At IOC we will be able to control the Navstar Global Positioning System and Defense Support Program satellites. An additional capability to control the Defense Meteorological Satellites will occur in Fiscal Year 1988. The SOPC is currently scheduled for an Initial Operational Capability in Fiscal Year 1989.

### 10. Space Test Program

a. MISSION: The Space Test Program (STP) advances DoD technology by providing spaceflight missions for experiments that demonstrate new space system technologies, concepts, and designs and for experiments that determine space environmental effects on DoD space systems. This tri-service program provides the only substantial spaceflight capability to perform fly-before-buy demonstrations of advanced technology designs. The STP is the pathfinder for exploiting the Space Shuttle as a manned DoD space laboratory to expedite the infusion of new technology into space systems through the use of simpler, incrementally designed, man-aided experiments. The experience gained from this approach will be a key element in fully defining military man's role in space.

b. STATUS: During 1985 the STP provided space flight for 17 experiments (including five reflights) on various Shuttle missions. The newly launched experiments included 14 Quick Response Shuttle mid/aft-flight deck payloads on four different Space Shuttle flights. These experiments included oceanographic, meteorological, and radiation measurements as well as laser tracking and biotechnology investigations. The remaining three experiments were flown in NASA Get-Away-Special canisters in the Space Shuttle payload bay. These experiments included space ultraviolet measurements and the deployment of the Defense Advanced Research Projects Agency sponsored Global Low Orbiting Relay Satellite.

During Fiscal Year 1986 NASA and STP continued to work on the Combined Release and Radiation Effects Satellite (CRRES) mission. This joint program will develop and launch a Shuttle compatible, free-flying spacecraft to perform a NASA chemical release mission during its three month flight profile in low earth orbit and then boost itself into a high-altitude, elliptic orbit for a DOD mission to evaluate the performance of advanced microelectronic components in a high-radiation space environment. The Air Force will fund the CRRES spacecraft and NASA will fund the Shuttle integration and launch the spacecraft currently scheduled for the fourth quarter of Fiscal Year 1987. Data from both CRRES missions will support development of future DoD and NASA spacecraft.

## C. Satellite Systems

1. **Rationale**: U.S. space systems significantly enhance the effectiveness of our ground forces. The global coverage and critical near real-time information that satellites provide are becoming increasingly more important. In fact, many of the tasks performed by our satellites can only be done effectively from space.

2. **Current Systems:** Three Air Force space programs, the Defense Meteorological Satellite Program (DMSP), the Navstar Global Positioning System (GPS), and the Nuclear Detection System (NDS) perform a broad spectrum of missions for the DoD. The DMSP provides weather data, the GPS position and mapping data, and the NDS nuclear detection and location.

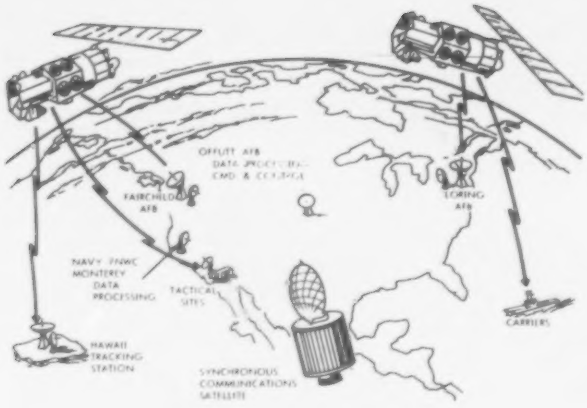
3. **Future Systems**: Upgraded systems are being developed to improve mission performance, duration and survivability. Efforts include mission area planning to broadly examine Air Force capabilities, potential deficiencies and establish development goals in the areas of high frequency communications, advanced tactical battle management and military space station requirements.

## Fiscal Year 1987 PROGRAMS

### 4. The Defense Meteorological Satellite Program

a. **MISSION**: The Defense Meteorological Satellite Program (DMSP) is the DoD's single most important source of weather data. The program is a joint service program with the Air Force serving as executive agent. DMSP provides total earth coverage of meteorological, space environmental, and oceanographic data to Air Force and Navy forecasting centers. In addition, it directly transmits real-time cloud imagery data to Air Force, Navy, and Marine Corps fixed and mobile terminals and Navy aircraft carriers.

b. **STATUS**: The major Fiscal Year 1987 effort will be the continued development of the Block 5D-3 Titan II Space Launch Vehicle qualified spacecraft. Production of the new Mark IV advanced mobile tactical transportable weather terminals for the Air Force and Marine Corps will continue. Integration of command and control hardware into the DMSP Fairchild Satellite Operations Center will begin. Further, the Satellite Control Facility antenna system at the Thule Air Base, Greenland, tracking station is being improved to receive and transmit DMSP command and control and data signals.

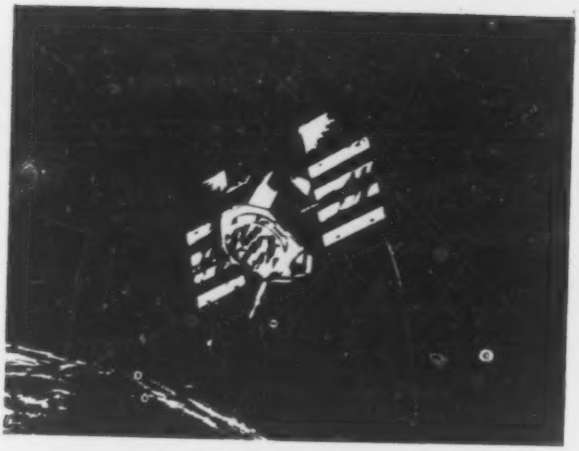

OFFUTT AFB
DATA PROCESSING
CMD & CONTROL
FAIRCHILD AFB
LORING AFB
NAVY FNWC MONTEREY DATA PROCESSING
TACTICAL SITES
CARRIERS
HAWAII TRACKING STATION
SYNCHRONOUS COMMUNICATIONS SATELLITE

*DEFENSE METEOROLOGICAL SATELLITE PROGRAM*

### 5. Navstar Global Positioning System

a. MISSION: The Navstar Global Positioning System (GPS) is a space-based radio navigation system which will provide joint service users highly accurate three-dimensional position, velocity, and precise time under all weather conditions on a worldwide basis. When fully operational at the end of 1988, GPS will enable land, air, and sea forces to navigate with extremely high accuracy and be independent of limited-range terrestrial navigation aids. GPS will significantly improve the probability of target acquisition, low-level navigation to and from the target, flexible routing and, most importantly, accuracy of weapons delivery. In addition, a civil version of GPS will also be available for worldwide civil use at reduced accuracy. The GPS system includes a space segment, a control segment, and user equipment. Successful development led to the award of a multiyear production contract for 28 satellites in Fiscal Year 1982. The multiyear contract remains within the cost, schedule, and performance parameters approved by Congress.

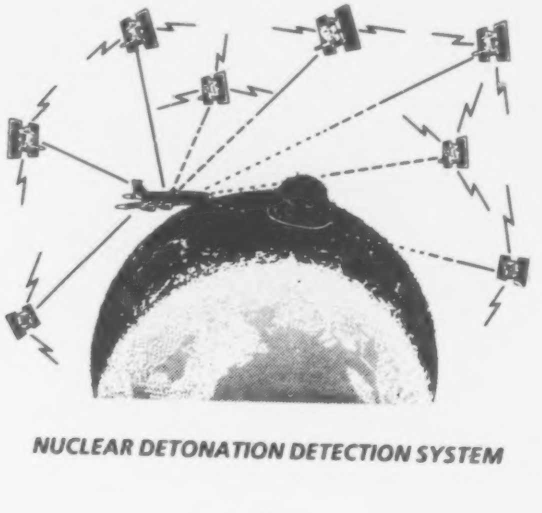
b. STATUS: The last GPS development satellite was launched on October 8, 1985. The Fiscal Year 1987 funds will be used to purchase eight satellites to continue the GPS multiyear contract, to procure and install user avionics on DoD aircraft. Also included is continued funding to support the seven-satellite research and development constellation, which includes mapping, missile testing and avionics integration testing activities. User equipment production, which will provide the services with a family of GPS receivers, will continue. First deliveries are planned for early Fiscal Year 1988.



*NAVSTAR GLOBAL POSITIONING SYSTEM*

### 6. Nuclear Detonation Detection System

a. MISSION: The Nuclear Detonation Detection System (NDS), also known as the Integrated Operational NUDET Detection System (IONDS), consists of a set of sensors that will be carried on Navstar GPS satellites. When used with the precision frequency standards of the GPS, these sensors will determine nuclear detonation location, time, and yield.



*NUCLEAR DETONATION DETECTION SYSTEM*

b. STATUS: Prototype sensors are operational on three GPS developmental satellites. In Fiscal Year 1987 we will continue development and test of the NDS user terminals and acquisition of the operational satellite segment. A full NDS capability will be achieved in Fiscal Year 1989 when the GPS/NDS satellite constellation is on orbit.

*F-16 FIGHTING FALCON DROPPING 2000# BOMBS*

# VIII. Theater Forces

## A. Objectives

In order to protect our national interests and meet our extensive commitments, we must have forces capable of countering any conventional threat. Because of the magnitude of our global commitments and the time critical nature of our responses, our forces must have the capability to react and fight anywhere and anytime. To operate in this environment, we are placing high priority on modernization and expansion of our theater forces while continuing to emphasize readiness and sustainabilty.

## B. Tactical Fighter Program

### BACKGROUND

1. Rationale: At the core of our theater force capability is the tactical fighter force. This force must provide field commanders the flexibility to respond in an appropriate and timely manner to any contingency. This flexibility requires a fighter force large enough to do the job and one which possesses the proper mix of air-to-air and air-to-ground weapons delivery capabilities. Two years ago, we developed the Tactical Fighter Roadmap to guide us in achieving and maintaining that fighter force. Since then we have updated it in response to changing threats and fiscal constraints.

2. Soviet Threat: The Soviet Union and her allies continue to out-produce U.S. and our allies in nearly all weapons categories. This disparity has resulted in a Warsaw Pact numerical advantage of almost three to one over North Atlantic Treaty Organization forces in mobile armored systems with a similar advantage in tactical aircraft. Soviet technical advances in avionics, aerodynamics, and propulsion systems are narrowing our qualitative advantage. The Soviet's newest fighters (MIG-29 Fulcrum, MIG-31 Foxhound, SU-27 Flanker) are comparable to our frontline F-15 and F-16 aircraft. This quantitative and qualitative expansion presents the most serious threat to our theater forces. We are addressing that challenge by using our advantages in technology and tactics to provide our dedicated and well trained people the most capable equipment we can produce within present fiscal constraints.

3. Tactical Fighter Roadmap: The Air Force has established a force structure goal of 40 tactical fighter wing equivalents. Though this level falls short of that actually required, it represents a practical and fiscally achievable goal within the Fiscal Year 1987 Five Year Defense Plan. Reaching this goal, while maintaining the tactical fighter force at an acceptable average age of approximately ten years, requires that we increase our tactical fighter procurement to at least 260 aircraft per year. Our Fiscal Year 1987 request, consequently, is for 264 aircraft (48 F-15E and 216 F-16 C/D).

In addition to the tactical force, we have a pressing need to replace the aging F-4s and F-106s in our Continental Air Defense Force. In order to accomplish this in the most affordable and cost-effective manner possible, we are conducting a competition for approximately 300 air defense aircraft. The competition will be conducted in Fiscal Year 1986 and will be open to all existing aircraft.

Aircraft competition is but one of the innovative approaches we are applying to build and maintain the forces required to protect our national interests. In addition, we are studying new modification programs for current inventory aircraft which may provide increased capability and supportability and thereby increase useful service life. We are also establishing cost goals earlier than ever before in the development of future systems and applying goals to operating and support costs as well as procurement. We have and will continue to explore every available avenue to build and maintain our forces at the required levels. The Tactical Fighter Roadmap will continue to be revised and updated so that we can achieve our objectives in the most cost effective manner possible.

## Fiscal Year 1987 PROGRAMS

### 4. F-15 Eagle

a. MISSION: The F-15E provides the dual capability of performing all-weather navigation, deep penetration, and night/under the weather air-to-surface attack, while retaining the basic air-to-air capabilities of the F-15A-D. We are adding the systems, such as Low Altitude Navigation and Targeting Infrared for Night (LANTIRN) and a missionized rear cockpit, that the F-15E needs to perform its ground attack mission. The F-15E will complement the limited F-111 fleet. At comparable loads, the F-15E has less range than the F-111 but is capable of delivering a wider variety of air-to-surface munitions. In the air-to-air arena, the F-111 can defend itself while the F-15E can conduct offensive counter-air operations. The F-15A/B air superiority version was introduced into the Reserve forces with the activation of the first unit at New Orleans Air National Guard Base in October 1985.

*F-15 EAGLE*

b. STATUS: We accepted delivery of the first Multistage Improvement Program (MSIP) F-15 production aircraft in June 1985. The MSIP program is designed to provide improvements to meet evolving threats. Improvements include software changes to the radar system, adding Advanced Medium Range Air-to-Air Missile (AMRAAM) capability, incorporating improved communications and identification equipment as well as updating the electronic warfare system. The MSIP F-15 configuration serves as the baseline for the F-15E.

With Fiscal Year 1987 Research, Development, Test and Evaluation (RDT&E) funds, we will continue testing of the integrated MSIP systems, MSIP Radar Electronic Counter Counter Measures updates, continue development of the Tactical Electronic Warfare Systems support equipment, and integration of an increased performance engine. F-15E unique tasks in Fiscal Year 1987 include hardware/software development, in-depth ground testing, and initial flight testing.

In Fiscal Year 1986, we will procure the last of the F-15 C/Ds and the first eight of a total of 392 F-15E aircraft. Our Fiscal Year 1987 request will purchase 48 F-15E aircraft. The first F-15E delivery is scheduled for December 1986.

### 5. F-16 Fighting Falcon

a. **MISSION**: The high performance multi-mission F-16 performs a broad spectrum of tactical air warfare tasks coupling exceptional air-to-air performance and potent air-to-surface delivery capability. The F-16, rapidly becoming the backbone of our fighter fleet, is replacing aging F-4s in the active and reserve forces. The F-16 is operated by 28 active and two reserve/guard units in air-to-air and air-to-surface roles. Five Air Reserve Force units will convert to the F-16 in Fiscal Years 1986 and 1987. The F-16 serves in the air forces of nine nations worldwide.

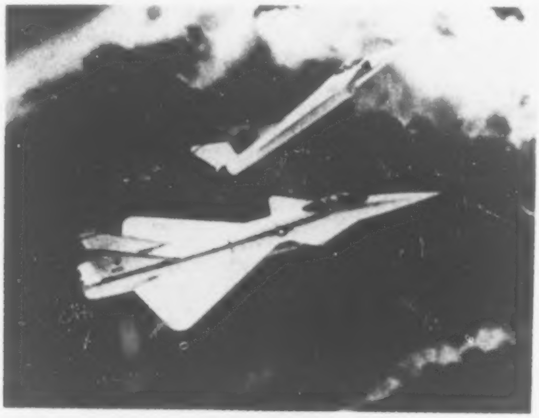
*F-16 FIGHTING FALCON*

b. **STATUS**: The F-16 continues to evolve in capability. We continue to improve airframe, engine, and aircraft subsystems so that the F-16 can counter the increased Soviet quantitative and qualitative threat. Fiscal Year 1986 development activities include production incorporation of AMRAAM capability and robust electronic warfare countermeasures provisions. We are also developing a digital flight control system to provide, in conjunction with LANTIRN, a night, under-the-weather mission capability. Our Fiscal Year 1987 program will continue development efforts on radar Electronic Counter-Countermeasures. We are developing a retrofit kit for early model F-16 A/Bs to allow employment of new weapons such as AMRAAM and to baseline a common configuration with our European partners.

Our Fiscal Year 1987 request funds 216 F-16 C/D aircraft during the second year of the F-16 follow-on multiyear contract. The original multiyear contract saved $257 million. We expect to realize greater savings as a result of the second multiyear contract.

### 6. Advanced Tactical Fighter

a. MISSION: To meet the threats of the 1990's, we are developing the air superiority fighter of the future, the Advanced Tactical Fighter (ATF). This aircraft will counter the next generation of Soviet fighters that will have maneuvering capability and fire control systems vastly superior to most advanced F-15 and F-16s. The possibility of operations in areas such as Southwest Asia demand an aircraft with greater combat radius, more rapid deployment capability, a low observable signature, and reduced logistics support than our present fighters. Through the application of signature control, supersonic cruise and maneuver, and advanced avionics, the ATF will provide a dramatic increase in lethality, survivability and offense capability to ensure air superiority after the mid-1990s.



***ONE POSSIBLE TYPE OF ADVANCED TACTICAL FIGHTER***
***Artist's Concept***

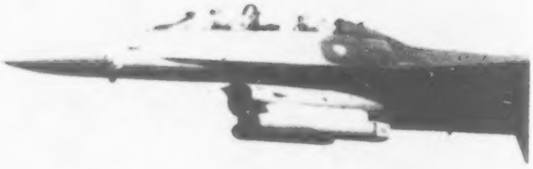
b. STATUS: We are proceeding toward the selection of three or four contractor teams who will demonstrate/validate the respective ATF concepts through detailed design analysis, mission effectiveness testing, and wind tunnel testing. The Request for Proposal was released on October 8, 1985. The RFP sets a design-to-cost goal of $35 million (Fiscal Year 1985 $) for the unit flyaway cost. We will also establish design-to-cost goals for unit production cost, annual operation and support costs, and twenty year Life Cycle Costs. We expect the demonstration/validation contractors to plan high levels of competition at subsystem and component piece part levels. We anticipate Milestone I approval in mid-Fiscal Year 1986. The Demonstration/Validation Phase, continuing through Fiscal Year 1989, will place heavy emphasis on hardware risk-reduction efforts in key ATF technologies. We expect to select an ATF design and begin full scale development in Fiscal Year 1989. We are driving toward a 1995 Initial Operational Capability.

The engine for this aircraft will have significant capability improvements over current engines. During Fiscal Year 1985, we completed the engine design and fabricated critical engine components. In Fiscal Year 1986, we will complete fabrication of demonstration engines and begin durability and performance demonstrations. In Fiscal Year 1987 we will continue durability and performance demonstrations and conduct accelerated mission testing. We plan to have over 800 hours of engine testing prior to transitioning to full scale development in Fiscal Year 1989.

### 7. Low Altitude Navigation and Targeting Infrared for Night

a. **MISSION**: Soviet and Warsaw Pact armored forces are becoming stronger. These forces equipped with night vision capability and accurate laser ranging systems assure a continued enemy thrust during night and adverse weather. To counter this threat, we must be able to fight in these conditions. We consider lack of night attack capability to be the most serious operational deficiency in our tactical air forces today. The Low Altitude Navigation and Targeting Infrared for Night (LANTIRN) system opens up the night window and denies the enemy this sanctuary. LANTIRN provides the capability for the F-15E and F-16 C/D to ingress the target area below enemy air defenses at night and in conditions of limited visibility. It also provides the capability to acquire and accurately attack tactical targets with the Imaging Infrared (IR) Maverick, laser-guided bombs, and other conventional ordnance.

b. **STATUS**: Since we capped its cost in early 1983, the LANTIRN program has been stable and remains on track from a cost standpoint. Eighty percent of the development effort is behind us. We have completed Initial Operational Test & Evaluation (IOT&E) of the navigation pod and the results were excellent. We flew more than 570 sorties and over 100,000 miles under 500 feet with over 50,000 miles at night. Our follow-on testing of the navigation pod Reliability and Maintainability fixes has produced excellent results. Pod reliability now stands at approximately 29 hours, well ahead of the projected 18 hours. The navigation pod is in production with Lot II placed on contract in early 1986. The targeting pod, as we stated last year, did not mature as fast as the navigation pod. During the past year, we have conducted additional testing, and recent test results have been very encouraging. We have corrected the problems noted in earlier testing. Our pilots have noted overall improvement in the Forward Looking Infrared (FLIR) picture and tracker stability. These pilots have been able to "lock on" to vehicle sized targets at six nautical miles (nm) (3-4 nm was expected). The system has also made numerous IIR Maverick missile handoffs. As of January 10, 1986, we have flown the pod on 349 sorties over 60,000 miles, with 20,000 miles at night. We began IOT&E in January 1986. We will make the targeting pod production decision this Spring.



*F-16 WITH LANTIRN PODS*

Both the development and production programs are under firm fixed-price contracts. We have exceptional warranty provisions and stringent reliability requirements. The contractor will repair all failures for up to 24 months or 400 operating hours on all pods at no cost to the government. The production contract is for 700 pod sets and 29 sets of Intermediate level support equipment.

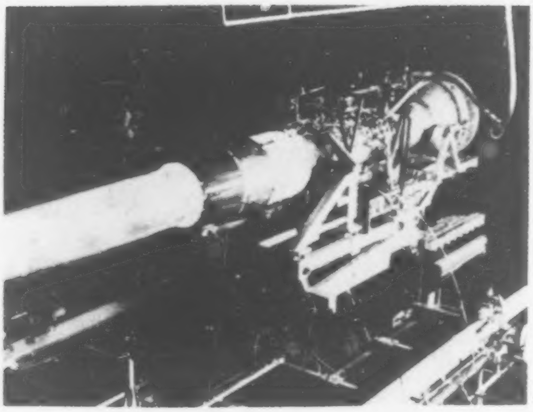
The first navigation pod production delivery is scheduled for April 1987. The first target pod will be delivered in April 1988. Initial Operational Capabilities are 1989 and 1990 respectively.

Our Fiscal Year 1987 research and development request supports F-15E/ LANTIRN and F-16/Auto Terrain Avoidance flight testing and continues support equipment development. Our procurement request will buy 143 navigation pods, seven targeting pods, six sets of support equipment, and spares.

### 8. Engine Model Derivative Program

a. **MISSION**: The Engine Model Derivative Program (EMDP) provides air vehicle systems with the latest advances in engine technology and provides a framework for engine development for future systems. It demonstrates derivative engine concepts incorporating new low-moderate risk technology in the areas of performance, durability, operability, supportability, reliability, maintainability, and other engine capabilities, i.e., thrust reversing/thrust vectoring, in prototype engines prior to full scale development. EMDP provides competitive alternate engine candidates for military aircraft.

b. **STATUS**: Under the EMDP umbrella, we currently have two engine demonstration programs. We are finishing the F100 EMDP test program. The F100 EMDP engine is a 27,000 pound thrust class growth version of the current Pratt and Whitney F100-220 Alternate Fighter Engine (AFE) engine. The higher flow fan and full life low pressure turbine developed for this EMDP engine will be used in the Pratt and Whitney F100 Increased Performance Engine (IPE) design.



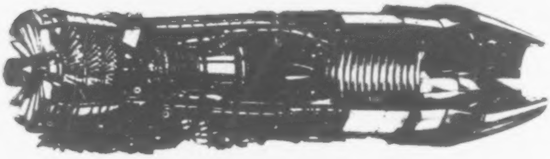
*ENGINE TEST FOR THE ENGINE MODEL DERIVATIVE PROGRAM*

This past summer we began our second demonstration program, the F100/F110 Increased Performance Engine program. This program will yield valuable data which will be used during full scale development. Pratt and Whitney and General Electric have completed the preliminary design reviews for their respective 29,000 pound thrust class derivatives of the F100 and F110 AFE engines. We will begin demonstration engine testing in Fiscal Year 1986. Each demonstration engine will accumulate approximately 4,000 cycles of operation. We will make a Full Scale Development decision for these engines in May 1986. Fiscal Year 1987 will be a transition year, where we will transfer our efforts from these demonstration programs to full scale development under the Alternate Fighter Engine program.

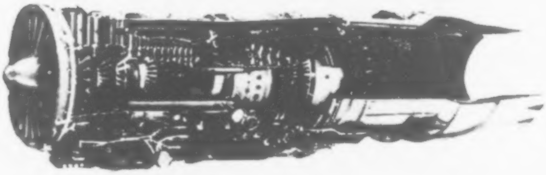
### 9. Alternate Fighter Engine

a. MISSION: The Alternate Fighter Engine (AFE) program supports the Tactical Fighter Roadmap by providing durable, supportable, and affordable fighter engines for the expanding F-15 and F-16 fighter forces. Program activity also includes configuring engine bays in both aircraft to be capable of receiving either the Pratt & Whitney F100 or the General Electric F110 engines. This program also funds full scale development for the increased performance version of F100 and F110 scheduled for 1990 delivery.

b. STATUS: In Fiscal Year 1986, we will complete the Alternate Fighter Engine development. We began quantity production of both the F100 and F110 engines in January. The first delivery of an F-16 C/D with the General Electric F110 engine is scheduled for July 1986. We also will fabricate development hardware for the F-15 Configured Engine Bay. In May 1986, we expect a full scale development decision for the F100/F110 Increased Performance Engine (IPE) program. This decision will be based on favorable critical design reviews for both engines. In Fiscal Year 1987, we will assemble FSD and flight test engines. We will also begin sea level engine testing and flight testing of pre-production prototype engines. In the coming years, we will put each engine through over 1000 hours of ground testing and a 4000 Total Accumulated Cycles accelerated mission test. If all goes according to plan we would expect to deliver the first production IPE engine in January 1990.



*GENERAL ELECTRIC F110 AFE*



*PRATT & WHITNEY F100 AFE*

### 10. INEWS/ICNIA INTEGRATED AVIONICS

a. **MISSION**: Since World War II new electronic systems have been added piecemeal to our combat aircraft -- as individual stand alone avionics systems. With the increasing reliance upon more sophisticated and complex avionics systems to assist the pilot in accomplishing his mission, the costs of developing and integrating individual systems into aircraft one at a time have become prohibitive. The Integrated Electronic Warfare System (INEWS) and the Integrated Communications, Navigation, Identification Avionics (ICNIA) system are making major changes to the way we add new capabilities to our avionics suites. These systems will be made up of hardware and software modules which can be put together in various combinations to tailor the operational capability to the mission of the particular aircraft type.

b. **STATUS**: The INEWS is now finished concept definition and source selection is currently underway to pare down the five different contractor team's concepts to the two best concepts. These two will enter the demonstration/validation phase in May 1986. The ICNIA contractors have completed critical design review, and are now constructing hardware and coding software for their competing designs. Delivery of the first advanced development model ICNIA radio is scheduled for December 1987.

INEWS continues as a joint Air Force/Navy program targeted for the Advanced Tactical Fighter (ATF) and Advanced Tactical Aircraft (ATA). The Navy has joined the Air Force and Army in the ICNIA program, adding the ATA, F-14D, and F/A-18 to the ATF, F-16, F-15, and LHX as potential users of the system.

## C. Munitions Acquisition

## BACKGROUND

1. **Rationale**: The Soviets continue to maintain a large well-equipped ground force. This offensively oriented force capable of large scale, theater wide combined arms operations posses a serious threat to the NATO alliance. The Soviets are posturing themselves to be able to achieve their goal of attaining a quick victory in theater warfare through the rapid advance to deep theater objectives. We must be able to counter any attack with conventional forces.

2. **Threat**: The Soviets have 213 maneuver divisions with an extensive support structure, including artillery, missile, air defense, engineer, reconnaissance, signal, chemical, and logistics units. Tank and motorized rifle and airborne divisions constitute their basic maneuver forces. This force is continuing to grow and be modernized continually. The Soviets are also expanding and upgrading their support structure. Their goal is the concentration of overwhelming firepower to achieve advantageous force ratios.

3. **Munitions Acquisition Plan**: Sophisticated Soviet and Warsaw Pact defenses make overflight of high value targets increasingly hazardous. Warsaw Pact numerical superiority in armored vehicles dictate multiple-kills-per-pass weapons. Soviet numerical air superiority drives us toward launch and maneuver air-to-air weapons. Obviously there are situations that do not require such sophisticated weaponry, nor are we able to buy all the precision guided munitions we require. A plan was developed, therefore, to help us determine the optimum mix of conventional air delivered munitions. Just as the Tactical Fighter Roadmap

guides our force structure development, the Munitions Acquisition Plan (MAP) guides our air-delivered munitions development and procurement. The MAP addresses our near term shortfalls and represents the Air Force position on what weapons should be procured. The MAP presents a listing of our research, procurement, and advanced development efforts in priority sequence. This listing is useful particularly in situations involving severe financial constraints. The President's budget reflects the conclusions of the MAP.

## Fiscal Year 1987 PROGRAMS

### 4. Advanced Medium Range Air-to-Air Missile

a. MISSION: The Advanced Medium Range Air-to-Air Missile (AMRAAM) is a high performance launch and maneuver air-to-air missile which will help the U.S. and NATO tactical air forces compensate for the numerical advantage enjoyed by the Warsaw Pact. The AMRAAM is an all-aspect, all-weather, all-environment air-to-air missile for air superiority and air defense aircraft. This follow-on to the AIM-7 Sparrow has significantly improved operational utility and combat effectiveness. The missile provides the attacking aircraft with the capability for multiple target attack during a single intercept. We will deploy the AMRAAM on the USAF F-15 and F-16, and the Navy F-14 and F/A-18. The AMRAAM is one of a family of missiles covered under the Four Power Memorandum of Understanding (MOU) with the US, United Kingdom, the Federal Republic of Germany and France (observer status). Under the agreement, we will develop AMRAAM for use by all participants. AMRAAM will satisfy the NATO operational objective for air-to-air missiles for the 1980's and beyond and will be compatible with the German F-4F and the United Kingdom's air defense version Tornado and Sea Harrier. The United Kingdom, West Germany, and Norway are developing the Advanced Short-Range Air-to-Air Missile (ASRAAM) which is a follow-on to the AIM-9 Sidewinder. Under the provisions of the MOU, we have agreed to mutual data sharing and technology transfer, along with the right to purchase, co-assemble, or dual-produce one another's missile system.

b. STATUS: On December 7, 1984, we began the Development Test and Evaluation (DT&E)/Initial Operational Test & Evaluation (IOT&E) program with the first full scale development AMRAAM (unguided) to verify that the missile meets specification requirements and to make an early operational assessment. We also began the guided test launch program and the Test, Analyze and Fix Program. We have had four successful launches in four attempts since we began the test launch phase. The Defense Systems Acquisition Review Council approved the continuation of the restructured program. Our emphasis in Fiscal Year 1986 is to reduce production costs through producibility enhancements, management initiatives, and by accelerating the follower contractor (Raytheon) to attain earlier competition. The Raytheon production qualification program begins and the producibility enhancement program continues in Fiscal Year 1986. In Fiscal Year 1987, we plan to begin a low rate initial production run of 260 missiles with both contractors. We plan a full competition for production by Lot III (95% of the total projected procurement will be under competition). This competitive procurement coupled with the producibility enhancements will allow for production of the 17,000 missiles within the $5.3 billion (Fiscal Year 1984 $) cost cap established by Congress. In Fiscal Year 1988 we also will complete the F-15 and F-16 DT&E/IOT&E program as well as the F-16 Captive Carry Reliability Program.

*F-16 WITH AMRAAM*

### 5. Advanced Short-Range Air-to-Air Missile

a. MISSION: The Advanced Short Range Air-to-Air Missile (ASRAAM) is planned to be the next generation short range air-to-air missile. ASRAAM equipped aircraft will be able to outshoot threat aircraft equipped with AIM-9L/M Sidewinder-equivalent weapons. The ASRAAM is optimized for close-in combat where all-aspect, high velocity, high maneuverability, off-boresight capability, and seeker acquisition and tracking are critical performance requirements. As mentioned above, the European governments are developing ASRAAM. This cooperative effort will avoid duplicating development costs, provide options for coproduction and increase NATO standardization and interoperability.

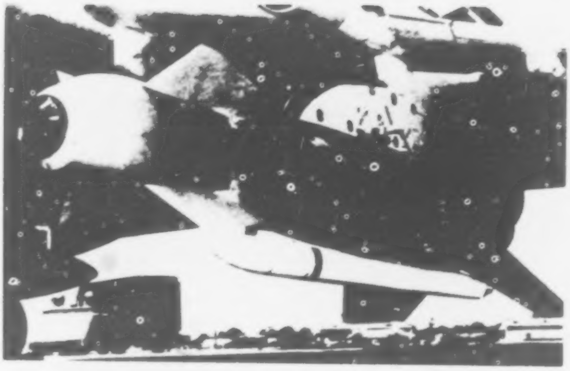
b. STATUS: The ASRAAM program is a new start. We will use the requested funds to provide a continuous liaison during the development effort. Our program office will be at Eglin AFB in Florida. We will have representatives in the joint European program office in Koblenz, Germany. Our representatives will review ASRAAM technical and performance data and assess the impact on our aircrafts' performance as the ASRAAM design evolves. We will make a procurement decision after a complete review of missile cost, schedule, performance, reliability, and maintainability. Assuming a favorable decision, we could expect production missiles in the mid-1990s.

### 6. Surface Defense Suppression

a. MISSION: In this program, we are developing a family of modular guided weapons designed to destroy high value point targets and enemy defense sites. The GBU-15 is a glide bomb equipped with a television (TV) or Imaging Infrared (IIR) seeker. The AGM-130, a rocket powered GBU-15, is a highly accurate, medium-standoff weapon. Both weapons provide low altitude launch capability with high terminal accuracy through man-in-the-loop weapon control from launch to impact. The AGM-130 responds to the improving enemy air defense systems by allowing the attacking aircraft to move further from the target. These weapons employ the same seekers and data link. For hard target attack capability, we plan to integrate the Improved-2000 pound warhead into the AGM-130. The

GBU-15 family will be deployed with F-4E and F-111F aircraft. The AGM-130 will be carried by the F-15E in addition to the F-4E and F-111F.

*GBU-15 ON F-111*



*AGM-130*
*Artist's Concept*

b. STATUS: The GBU-15/TV version is in production. We are conducting Follow On Test and Evaluation on the IIR version. The IIR version will provide us with a night attack capability. The IIR seeker we are using is 90% common with the Maverick IIR seeker. We began AGM-130 development in September 1984. DT&E/IOT&E began in the fourth quarter of Fiscal Year 1985. We are able to reduce the development time because the AGM-130, a Preplanned Product Improvement, makes maximum use of GBU-15 in production hardware. The only major additions are the rocket motor and the radar altimeter. Based on favorable test results during Fiscal Year 1986, we will begin procuring tooling, test equipment, and production-proof AGM-130As. We will also begin full scale development of an improved data link. The data link is key to successful employment and high terminal accuracy for both the GBU-15 and the AGM-130A. In Fiscal Year 1987, we will continue GBU-15/IIR production and make a production decision on the AGM-130A. We will also continue developing the improved data link. Due to fiscal constraints, we have cancelled further efforts on the AGM-130B dispenser variant.

7. High Speed Anti-Radiation Missile

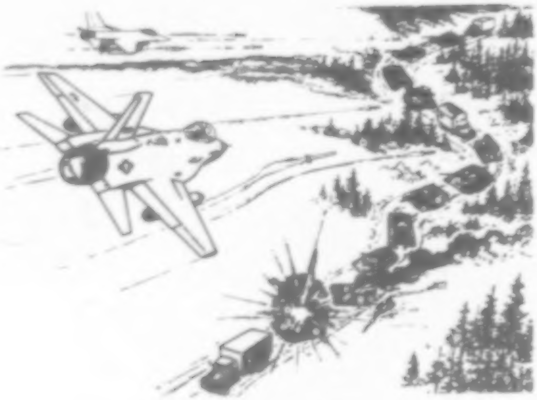
a. MISSION: The High Speed Anti-Radiation Missile (HARM) provides a destructive counter to sophisticated enemy ground based, radar guided missiles, and antiaircraft artillery systems which threaten our tactical aircraft survivability. The F-4G Wild Weasel equipped with the HARM represents our only dedicated lethal defense suppression weapon system. The HARM is a joint service effort with the Navy as the executive service.

*F-4G CARRYING HARM*

b. STATUS: We have been taking delivery of HARM missiles since December 1983. We achieved Initial Operational Capability in September 1984, at George AFB, California. We are requesting funds to procure 2130 missiles in Fiscal Year 1987. Our research and development request will be used to keep the HARM abreast of the threat. We plan software updates to improve performance against new radars. We are also planning hardware upgrades to reduce future hardware costs and improve HARM availability to the user. We anticipate concluding the product update program in Fiscal Year 1988. In addition, the joint Navy/Air Force Lower Cost Seeker program is proceeding in accordance with Congressional directives.

8. Hypervelocity Missile

a. MISSION: The Hypervelocity Missile (HVM) is a small, fast, low-cost, laser-guided munition which can achieve multiple-vehicle kills on a single pass. The HVM concept promises to give the U.S. an impressive increase in firepower for the anti-vehicular mission at an equally impressive decrease in cost per target destroyed. The HVM is a 5000 feet per second, 66 pound, low cost ($8.5 thousand) class missile for use against all vehicles, including armor. This advanced technology development program is a tri-service effort which maximizes component commonality.



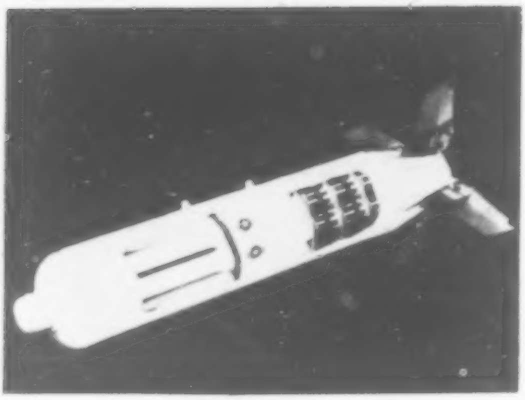
*F-16s ATTACKING TANKS WITH HYPERVELOCITY MISSILES*
*Artist's Concept*

b. STATUS: In Fiscal Year 1985, we amended the Air Force contract to include Army and Marine Corps requirements. We began missile component design. In Fiscal Year 1986, we will continue contractor design of missiles, launchers, and test equipment. We will also begin integration of the current fire control system. We will also conduct a weaponization study addressing aircraft integration and potential alternate fire control systems. We will complete missile fabrication in Fiscal Year 1987 and conduct ground and air launched testing. We expect to proceed into full scale development in Fiscal Year 1989.

### 9. Armament Ordnance Development

a. MISSION: In this program, we conduct our primary activities for modernizing and developing unguided air-to-surface conventional munitions, and associated carriage, release and handling equipment. Our efforts provide new capabilities to fill operational voids and modernize existing capabilities to eliminate deficiencies. Presently our major focus is the development of the Direct Airfield Attack Combined Munition (DAACM). DAACM is a Tactical Munitions Dispenser (TMD) containing eight Boosted Kinetic Energy Penetrators (BKEP) and 24 British HB-876 mines. DAACM will significantly improve our airfield attack capability and will be the successor to the currently procured French Durandal. The BKEPs provide multiple craters per weapon and the mines impede runway and taxiway repair operations as well as threaten aircraft.

b. STATUS: DAACM development (integration of BKEP and mines into the TMD) begins in 1986 with a source selection and contract award. In Fiscal Year 1987, we will conduct a critical design review, begin flight tests, and conduct a production readiness review. We will complete DT&E and IOT&E and make a Low Rate Initial Production decision in Fiscal Year 1989.



*DIRECT AIRFIELD ATTACK COMBINED MUNITION*

We are also developing the Transportable Missile Storage Rack, the Reusable Protective Device, the Improved 2000 pound (I-2000) warhead, and several warhead fuzes. The Transportable Missile Storage Rack and the Reusable Protective Device will be in source selection during Fiscal Year 1987. The Transportable Missile Storage Rack will allow high density storage and intra-theater air transportation of missiles. The Reusable Protective Device will allow us to place preassembled munitions in long-term storage protected from the elements. In Fiscal Year 1986, we will make a production decision on the I-2000 warhead.

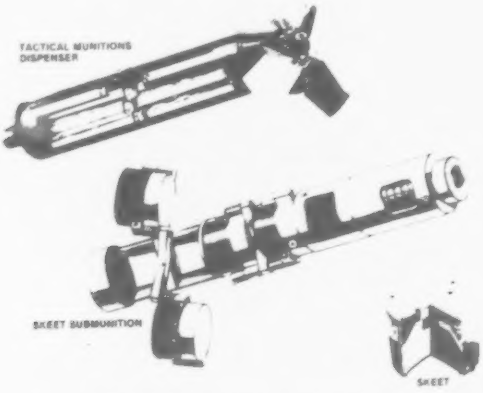
10. Hardened Target Munition

a. MISSION: The Hardened Target Munitions program will develop two new weapons for use against the expanding array of hard targets. The I-1000 will be a 1000-pound penetrating warhead with operational carriage and delivery flexibility beyond that of the I-2000 warhead. It is being developed for use with developmental standoff weapons. The boosted penetrator will provide capability beyond that available with the I-1000 and I-2000. This program will also continue to improve the I-2000. Improved fuzes and better targets to test penetrating weapons will be developed to support the development of these new weapons.

b. STATUS: This is a Fiscal Year 1987 new start. We consider the I-1000 a low risk development effort since it utilizes existing penetration technology demonstrated in the I-2000 program. We will award a development contract early in the year. We will begin wind tunnel and sled testing by the fourth quarter. In Fiscal Year 1988, we will begin DT&E/IOT&E and environmental/safety qualification testing. We expect to complete DT&E/IOT&E in November 1989 and make a production decision and contract award shortly after. The boosted penetrator will be a higher risk program. We are planning to conduct a free flight demonstration of the technology at the beginning of the full scale development program in Fiscal Year 1989.

11. Sensor Fuzed Weapon

a. MISSION: The Sensor Fuzed Weapon (SFW) will provide the capability to destroy multiple enemy tanks during a single pass. The SFW can be employed during night and adverse weather conditions permitting us to overcome the large numerical armor advantage of the Warsaw Pact. The 1000-pound Sensor Fuzed Weapon is a Tactical Munitions Dispenser (TMD) packaged with ten Skeet Delivery Vehicles each with four armor defeating warhead mechanisms. This mechanism is commonly called a Skeet. It consists of a self-forging warhead and an infrared detector. After being deployed from the delivery vehicle, the infrared detector locates hot areas on armored targets. When the hot spot is located, the mechanism fires the warhead. The SFW can be delivered from low altitudes.



*SENSOR FUZED WEAPON*

b. STATUS: In late Fiscal Year 1985, we successfully completed a risk reduction program for the Sensor Fuzed Weapon. The risk reduction effort addressed a fratricide problem that appeared during early testing. This fratricide effect was seen when the blast from the first warhead caused a second warhead to detonate. We believe we have solved this problem. The reduction program ended successfully with a full function test of a Skeet Delivery Vehicle. The delivery vehicle successfully ejected a full load of four Skeets. Each Skeet detected a separate tank target and fired its warhead which struck the target. We began full scale development in November 1985. A Critical Design Review is scheduled for July 1987. We will begin DT&E/IOT&E in Fiscal Year 1987 and will make a production decision in October 1988.

## D. Battlefield Management

### BACKGROUND

1. Rationale: It is not enough to provide a field commander aircraft and munitions. We must give him the capability to manage his forces in the prosecution of the battle. He needs eyes and ears to penetrate the "fog of war" to locate and target, ideally in real-time, enemy defenses, troop concentrations, and armored columns. He needs secure communications systems to pass time-critical data to command and control centers and friendly forces. He needs reliable, long-range methods for his ground and air forces to identify friend from foe. These capabilities are critical if he is to be able to adjust the order of battle, establish target priorities, and make effective use of our limited defense suppression and tactical jamming

assets. The Fiscal Year 1987 President's Budget provides a balanced program which responds to the threat and the field commanders needs consistent with our budgetary constraints.

## Fiscal Year 1987 Programs

### 2. E-3 Airborne Warning and Control System

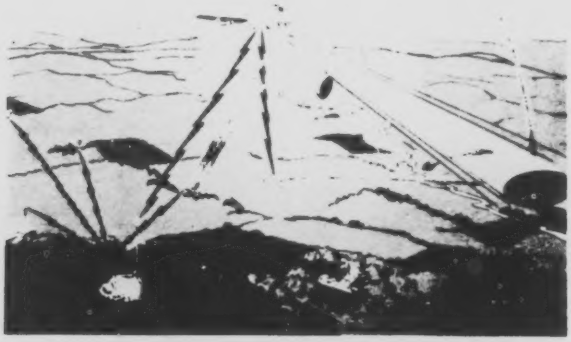
a. **MISSION**: The E-3 Airborne Warning and Control System (AWACS) overcomes ground based surveillance system deficiencies such as range, vulnerability, and effectiveness against low altitude targets. The AWACS provides real time management of the air battle in support of tactical air operations and in defense of the continental United States. Our ongoing program strives to maintain the AWACS as a viable system through command and control and electronic counter-countermeasures (ECCM) improvements.

*KC-10 REFUELING E-3 AIRCRAFT*

b. **STATUS**: In Fiscal Year 1985 we completed flight-test activities to place additional radios and multipurpose consoles on the aircraft. The communications electronic countermeasures (HAVE QUICK A-Net) improvement project will continue through Fiscal Year 1986 and complete development in early Fiscal Year 1988. During 1986 we will begin, with NATO, a cooperative development of an electronic support measures (ESM) addition to the U.S. and NATO E-3 Surveillance Systems. This addition will provide a passive detection, location, and identification capability against airborne, shipborne, and ground-based emitters. Development of this capability continues through 1989. Another major developmental activity underway is the development of the Joint Tactical Information Distribution System (JTIDS) Tactical Data Information Link "J" (TADIL J). TADIL J will provide secure jam-resistant communications with JTIDS equipped fighter aircraft. This development continues through Fiscal Year 1989. In Fiscal Year 1987 we will begin full scale development of the Improved Radar Data Correlator and improved Radar Control and Maintenance Console. These improvements will provide increased computer storage capacity and processor speed required by E-3 radar and ECCM updates and provide improved and expanded maintenance capabilities. They will also provide significant improvement in the reliability and maintainability of the present radar data correlator, and correct known deficiencies in the present radar control and maintenance console. We intend to install these modifications as well as the Global Positioning System and the Single Channel Ground and Airborne Radio System as a block update. The AWACS has served us well on worldwide deployments and we intend to maintain its capability to operate efficiently in future threat environments.

### 3. Joint Surveillance Target Attack Radar System

a. MISSION: The Joint Surveillance Target Attack Radar System (Joint STARS) provides an electronic "high ground" over the battlefield in order to delay, disrupt, and destroy first and second echelon Warsaw Pact armored forces and hamper their attempts to break through allied positions. The Air Force/Army Joint STARS will, in real time, detect, track, and pass exact enemy locations and position updates to friendly attack forces. Joint STARS will also provide Corps commanders with wide area surveillance information for timely maneuver of forces and battlefield management. Joint STARS is a critical element of the NATO follow-on force attack initiative. Joint STARS will be deployed on two platforms; an interim C-18 aircraft to meet the 1990s operational requirement and a follow-on more survivable platform later.



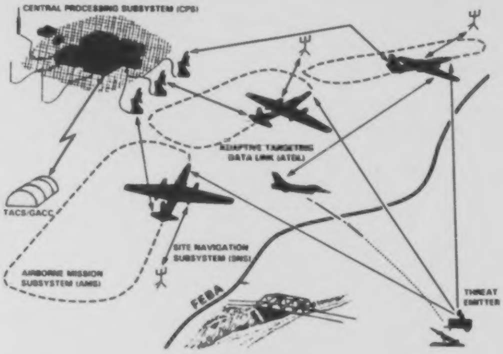
*JOINT SURVEILLANCE TARGET ATTACK RADAR SYSTEM*

*Artist's Concept*

b. STATUS: The Joint STARS full scale development contract was awarded to the Grumman/Norden/Boeing team on September 27, 1985. We are proceeding with the system and preliminary design phases and the refurbishment/modification of the C-18 test aircraft beginning with corrosion control and service bulletin compliance. During Fiscal Year 1987 we plan to complete development of the Ground Station Module and make a production decision. We will complete development test, and integration of circuit design hardware and will begin air worthiness flight tests. In Fiscal Year 1987, we expect to reach a Milestone IIB decision including a force structure resolution. We plan to begin a European Field Test Demonstration in October 1989 with a production decision in September of 1990.

### 4. Precision Location Strike System

a. MISSION: The Precision Location Strike System (PLSS) system can locate, within targeting accuracy, enemy air defense emitters in near real-time and provide this information to attacking forces who could employ PLSS targeted F-16s carrying conventional munitions. It will enhance the effectiveness of F-4G Wild Weasel/HARM aircraft, and EF-111 jamming aircraft by cueing them to their targets. PLSS is the only system possessing the detection capability, processing speed and target accuracy necessary to significantly reduce the attrition of friendly forces in European Theater. The TR-1 aircraft is the airborne relay vehicle for PLSS.

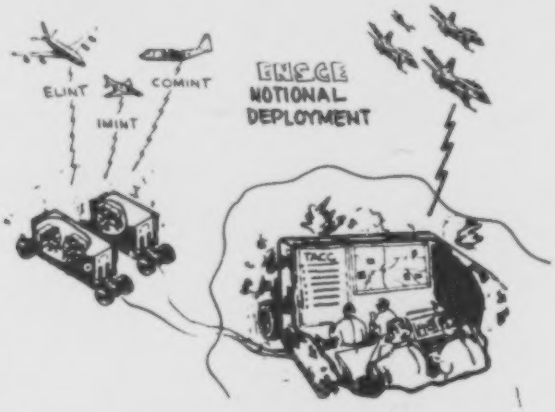

CENTRAL PROCESSING SUBSYSTEM (CPS)
ADAPTIVE TARGETING DATA LINK (ATDL)
TACS/GACC
SITE NAVIGATION SUBSYSTEM (SNS)
AIRBORNE MISSION SUBSYSTEM (AMS)
FEBA
THREAT EMITTER

*PRECISION LOCATION STRIKE SYSTEM*
*Artist's Concept*

b. STATUS: PLSS TRIAD aircraft test missions, which began in April 1985, have demonstrated system performance approaching or exceeding the threshold levels required for Air Force Systems Acquisition Review Council (AFSARC) IIIA milestone review. In October 1985 we awarded the construction contract for the PLSS hardened bunker. In Fiscal Year 1986 we will conduct DT&E/IOT&E at the contractor's facility and at Nellis AFB, Nevada. In 1986 we expect AFSARC IIIA decision on a limited production/refurbishment including advanced buy and long lead spares procurement. The AFSARC IIIA decision was delayed due to contractor integration difficulties during integration test flights. As a result, it will take longer to accumulate the required test data. We will conclude DT&E/IOT&E in Fiscal Year 1987 leading to a full production decision in mid 1987. We will refurbish the full scale development assets for deployment to the European hardened bunker.

### 5. Joint Tactical Fusion Program

a. MISSION: The Joint Tactical Fusion Program is developing the Army All Source Analysis System and the Air Force Enemy Situation Correlation Element (ENSCE) to rapidly receive, correlate, store and disseminate enemy target data from a large number of near-real-time, multi-discipline sensors. This data will be used in the battle management process by the Air and Ground Commanders and their staffs.



*ENEMY SITUATION CORRELATION ELEMENT*

b. STATUS: The ENSCE will satisfy Air Force requirements as stated in Tactical Air Forces Statement of Need 319-82. In Fiscal Year 1985 all system software and hardware contracts were awarded. A Preliminary Design Review was conducted in November 1985 and a System Critical Design Review is planned for August 1986. Delivery of the ENSCE baseline system will occur in Fiscal Year 1989. The Production Decision is scheduled for Fiscal Year 1990.

### 6. Tactical Air Control System

a. MISSION: The tactical air forces require a highly developed, reliable, positive control system to fully exploit the inherent capabilities of tactical air power. The Tactical Air Control System (TACS) provides the means through which the Air Force Component Commander exercises battle management control of his forces to accomplish his assigned mission. This program provides for major improvements to the existing TACS which was deployed in the sixties and is nearing the end of its useful life.

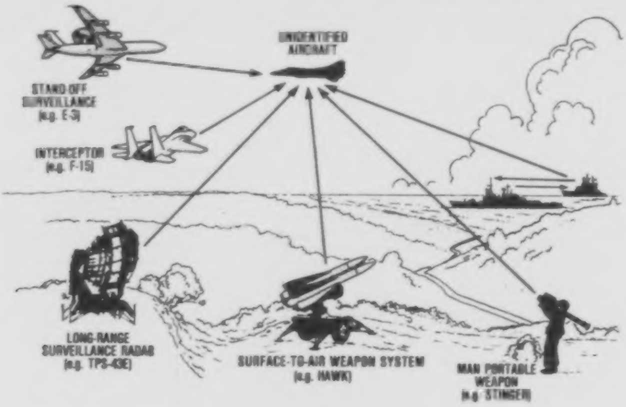
b. STATUS: In coordination with the Marine Corps, we are working to develop and acquire the Modular Control Equipment (MCE) to replace the aging TACS subsystems. MCE will provide the capability to handle a significant increase in $C^3$ workload, enhance service interoperability and reduce life cycle support costs. The Ground Attack Control Center System will incorporate MCE hardware components with additional software programs to provide the TACS with the capability to more rapidly control air attacks against time-sensitive mobile ground targets.

In addition to MCE production, we are procuring Ultra-Low Sidelobe Antennas and Anti-Radiation Missile Alarm Systems and continuing the Anti-Radiation Missile Development program for the AN/TPS-43E tactical radars. These will improve the radar's jam resistance and increase its survivability against anti-radiation missiles.

*TACTICAL AIR CONTROL SYSTEM*

7. Combat Identification System

a. MISSION: The Combat Identification System (CIS) will provide long-range reliable, secure identification of airborne targets in all weather, and in hostile electromagnetic countermeasure environments. Long-range identification optimizes the use of beyond visual range weapons to offset the Soviet numerically-superior threat. The thrust is to develop the Mark XV Identification Friend or Foe (IFF) system to replace the current Mark XII system. This is a tri-service effort in cooperation with our NATO allies thus ensuring interoperability.


UNIDENTIFIED AIRCRAFT
STAND-OFF SURVEILLANCE (e.g. E-3)
INTERCEPTOR (e.g. F-15)
LONG-RANGE SURVEILLANCE RADAR (e.g. TPS-43E)
SURFACE-TO-AIR WEAPON SYSTEM (e.g. HAWK)
MAN PORTABLE WEAPON (e.g. STINGER)

***COMBAT IDENTIFICATION SYSTEM***
***Artist's Concept***

b. STATUS: The Air Force is the lead Service for the Mark XV development. We, along with our NATO allies, have reached an agreement with the German government on the frequency band to be used and expect to complete technical refinements to this agreement by December 1986. The Mark XV efforts are presently in the Demonstration/Validation phase. In response to OSD direction, we restructured the Demonstration/Validation phase of the program and revised the Test and Evaluation Master Plan. Following OSD approval of the restructured program, we began fabricating several flyable advanced development models. During Fiscal Year 1986 we will complete the advanced development models, prepare Full Scale Development specifications, and the Request for Proposals. In Fiscal Year 1987 we will begin core, service-unique, and NATO interoperability testing of the advance development hardware and prepare for a DSARC II full scale developmen decision leading to a mid Fiscal Year 1988 start.

### 8. Infrared Search and Track System

a. MISSION: The Infrared Search and Track System (IRSTS) will increase aircraft survivability by providing a nonradiating capability to detect at increased range high altitude and/or low radar cross section targets. This passive intercept capability complements the intercepting aircraft's radar. Host aircraft for this system are the Navy F-14D and the USAF F-15. This technology is also applicable to the F-16 and Advanced Tactical Fighter (ATF) aircraft.

b. STATUS: This joint USAF/Navy effort transitions IRST technology into full scale development and pilot production. We released the request for proposal in September 1985 and expect to award a contract in April 1986. Close USAF/Navy cooperation during technology development will permit deliveries of Navy integration test units for the F-14D in March 1988. A joint USAF/Navy production decision will occur in Fiscal Year 1990.

### 9. Joint Tactical Communications Program

a. MISSION: The TRI-TAC program develops digital communications equipment for tactical operations. This program replaces the aging and outdated equipment now in use with a secure, anti-jam communications network. Equipment developments include transmission and switching equipment, system control facilities, local distribution equipment, terminal devices and interface equipment.

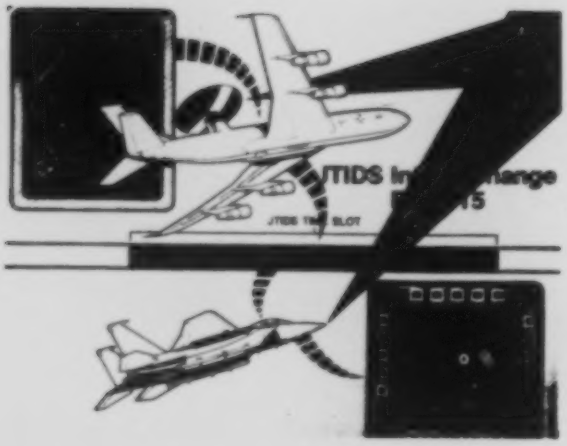
b. STATUS: The majority of TRI-TAC subsystems will continue in production during Fiscal Year 1987, including the AN/TRC-170 troposcatter radio, a family of digital message and voice switches and terminals, and Communications Nodal Control Equipment which performs automatic technical control functions. RDT&E efforts in Fiscal Year 1987 will continue to support design of peculiar support equipment for these systems, the integration and fielding of TRI-TAC communications equipment and start full scale development of electromagnetic, counter-counter measures capability of the AN/TRC-170 radio.

*TRI-TAC*

## 10. Joint Tactical Information Distribution System

a. MISSION: Critical information existing within the combat area must be made available quickly to combat units. The Joint Tactical Information Distribution System (JTIDS) system will provide secure message traffic, work in a severe jamming environment, and prevent hostile forces from intercepting and using transmitted information. JTIDS will provide sufficient connectivity and capacity to permit rapid and secure exchange of necessary command, control, and status information among all JTIDS equipped units in the tactical theater. This information is available to any user in real time. JTIDS will connect E-3 aircraft, combat and support aircraft, and ground, and shipboard command, control and surveillance centers. The NATO working group for the Mutifunctional Information Distribution System (MIDS) has recommended the adoption of JTIDS. On October 16, 1985, the Navy cancelled the Navy JTIDS program. In November 1985, OSD selected the Air Force JTIDS as the DoD JTIDS system.

b. STATUS: During 1985, we continued development of the E-3/ground (Class 1) terminal depot support equipment and the Class 2 fighter terminal. We also began development of a high powered version of the Class 2 terminal to be integrated into the AWACS aircraft and the ground Module Control Equipment (MCE) to provide these platforms with Tactical Digital Information Link "J" (TADIL J) JTIDS message standard capability. We conducted a successful demonstration flight of an F-15 equipped with a JTIDS Class 2 terminal on June 18, 1985. The F-15 transmitted and received voice and digital data to the JTIDS system exerciser unit located on the ground. We began DT&E ground testing in October 1985. Formal Flight testing begins in the second quarter of Fiscal Year 1986. In Fiscal Year 1987, we will complete IOT&E of the Class 2 fighter terminal for the F-15. We expect to make the Class 2 terminal production decision following IOT&E with first production deliveries beginning in mid 1989. Air Force RDT&E funds are included in the OSD common JTIDS funding request.



*JOINT TACTICAL INFORMATION DISTRIBUTION SYSTEM*

*Artist's Concept*

### 11. Advanced Communication Systems

a. MISSION: We must provide anti-jam Ultra High Frequency (UHF) and Very High Frequency (VHF) voice communications for our tactical fighter forces. The HAVE QUICK II program is applying demonstrated technologies to meet much of our requirement for jam resistant tactical command and control communications. The Single Channel Ground and Airborne Radio System (SINCGARS-V) is being developed for our tactical forces requiring direct communications with Army, Navy, and NATO forces. In addition, we have developed the Enhanced Joint Tactical Information Distribution System (EJS) wave form to provide a high anti-jam voice capability for potential application in future integrated communication systems to meet the long-term threat.

b. STATUS: The HAVE QUICK II program is developing operational enhancements and performance improvements to the frequency hopping HAVE QUICK system which we began deploying in 1981. During Fiscal Year 1985, we continued vulnerability analysis of the HAVE QUICK system and continued full scale development of improvements. We began production of expanded memory boards, and continued procuring HAVE QUICK capability for additional air and ground platforms. During Fiscal Year 1986 and Fiscal Year 1987, we will continue to develop and begin production on other improvements such as new control heads and alternate time dissemination.

The airborne SINCGARS-V system used in our close air support role is a form, fit, function replacement for the ARC-186 airborne radio. We completed source selection and began full scale development (FSD) of the airborne radio in Fiscal Year 1985. In Fiscal Year 1986 we will design, fabricate, and conduct in-plant test of DT&E/IOT&E hardware. In Fiscal Year 1987, we will complete FSD of the airborne radio including DT&E/IOT&E and finalize plans to exercise initial production options. We will also begin procuring Army-developed ground SINCGARS-V radios for our forward air control units.

The Enhanced JTIDS System capability will utilize the Joint Tactical Information Distribution System (JTIDS) developed Time Division Multiple Access (TDMA) architecture and the JTIDS frequency band for training and interoperability. For higher jam resistance, we will use a TDMA-like architecture in an alternate frequency band. In Fiscal Year 1985, we completed the system design review, and began efforts to fabricate development hardware. In Fiscal Year 1986 we will focus major efforts on transferring EJS design information to the Integrated Communication Navigation Identification Avionics (ICNIA) program for potential application in future production platforms.

## 12. Tactical Air Reconnaissance System

a. MISSION: Battlefield commanders need a continuing flow of intelligence information for planning and execution purposes. This information is collected by a mix of tactical reconnaissance platforms including standoff and penetrating manned and unmanned vehicles. These systems must provide near real-time detection, location, and classification of tactical targets. These systems include a pod or unmanned vehicle, a suite of electro-optical sensors, and a ground processing or exploitation station.

b. STATUS: The follow-on tactical reconnaissance pod has been renamed the Tactical Air Reconnaissance System (TARS) to more accurately reflect program activities. Both names are part of the overall concept of Advanced Tactical Air Reconnaissance System (ATARS) and represent the manned efforts. TARS focuses on the development of a common suite of electro-optical sensors, datalinks, recorders and ground station for application to the RF-4C and follow-on reconnaissance pod. Both the ground station and common sensor suite will have commonality with and application to the Unmanned Air Reconnaissance System. We envision that the form fitting pod will be carried on an F-15 or F-16. Fiscal Year 1985 and Fiscal Year 1986 TARS funding efforts were contained in the TARS program line. During Fiscal Year 1986, we will flight test a follow-on reconnaissance pod to determine stability and vibration characteristics, validate the sensor concept, and evaluate the ground station testbed. During Fiscal Year 1987, we will begin sensor pod design efforts, initial RF-4C engineering activity, and full scale development efforts of the sensor suite and ground processor capability.

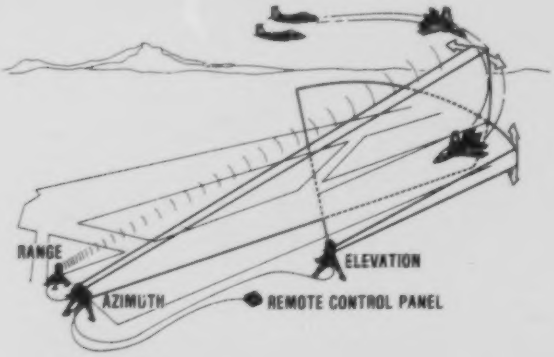
## 13. Unmanned Air Reconnaissance System

a. MISSION: As a complimentary capability to the Tactical Air Reconnaissance System, the Unmanned Air Reconnaissance System (UARS) is a program that will also meet a portion of the tactical commander's needs for detection, location and classification of tactical targets. The UARS will use a common sensor suite to include electron-optical sensors, data-links, and recorders provided under the Tactical Air Reconnaissance System program. UARS launch and recovery options are still being investigated.

b. STATUS: The UARS will use the common electro-optical sensors and ground exploitation station technology being developed for the TARS program. Following the pod tests in Fiscal Year 1986, reconnaissance requirements will be coordinated with the Navy and a reconnaissance roadmap and program development for achieving the required force structure. In Fiscal Year 1986, cost/performance trade-offs will be performed to determine if an expendable or recoverable vehicle will be the most cost effective option. UARS studies and concepts will be evaluated in conjunction with the Navy reconnaissance efforts. A full-scale development decision will be made in Fiscal Year 1989.

14. Traffic Control and Landing Systems

a. MISSION: The Traffic Control and Landing Systems (TRACALS) program provides the Air Force with the air traffic control and landing equipment required for safe, efficient, worldwide, all weather flying operations. The mission need is to provide take-off, enroute, and landing guidance and surveillance in order to meet wartime sortie requirements. In peacetime, the need is to support training, logistics, and other operational flying with maximum safety.



*TRAFFIC CONTROL AND LANDING SYSTEMS*

b. STATUS: The U.S. has agreed to adopt the international standard Microwave Landing Systems (MLS) in place of our existing Precision Approach Radars and Instrument Landing Systems. In Fiscal Year 1987, TRACALS plans to develop a Mobile MLS; update of the air traffic control surveillance equipment to make our fixed base systems survivable in combat. A new Mobile Radar is being planned for replacement of 1950 vintage systems. Existing Marine Air Traffic Control and Landing Systems development will be used where possible.

## E. Defense Suppression and Electronic Combat

### BACKGROUND

1. Rationale: Increasingly complex high technology weapon systems are appearing on both sides of the modern battlefield. Many of these systems make use of some portion of the electro-magnetic spectrum. In addition to radio, and radar and infrared subsystems, new systems make use of optical, electro-optical, ultraviolet and laser technology. For our forces to operate effectively, they must have clear access to these portions of the electro-magnetic spectrum. At the same time, they must have the capability to deny enemy forces use of this spectrum by exploiting their electro-magnetic vulnerabilities. This exploitation can take the form of destruction or deceptive measures or self-protection techniques such as chaff, flares, radar warning, and jamming systems, application of radar absorbent material, or employment factors.

2. Threat: The Soviet Union has the most comprehensive air defense system in the world. In the European theater alone the Soviets have concentrated over 10,000 surface-to-air missile (SAM) launchers and antiaircraft artillery (AAA) pieces. One of their newest weapons, the SA-11, features an on-board radar, increased mobility, and increased target handling capability. The Soviet SA-X-12 will be able to counter high performance aircraft and will also have capability against tactical ballistic missiles. This air defense system provides broad coverage for all altitude defense in all weather conditions. In addition, the Soviets are developing their MAINSTAY AWACS program. This aircraft will substantially increase the Soviet early warning and command and control capabilities. Soviet research and development continues to develop well designed, technically advanced air defense and Command, Control and Communications systems. It is these improvements in surveillance, identification and target tracking capabilities that our efforts are designed to over come.

3. Current Systems: Our current assets include the highly effective F-4G Wild Weasel/HARM weapon system, the EC-130 Compass Call aircraft, the EF-111 Tactical Jamming System and a variety of Electronic Countermeasures pods and chaff and flare dispensing systems.

4. Future Systems: Our thrust is to provide updated or new capabilities to our aircraft already in service. We are updating the F-4G Wild Weasel and EF-111 Raven systems to permit them to operate effectively into the 1990s. For our fighter aircraft we are updating our present jamming pods, flare dispensers, and radar warning systems. We are developing new capabilities such as the internal Airborne Self-Protection Jammer for the F-16. We are also studying our future Suppression of Enemy Air Defense needs.

## Fiscal Year 1987 Programs

### 5. F-4G Wild Weasel

a. MISSION: The F-4G Wild Weasel can autonomously detect, identify, locate, engage, and destroy hostile radars. The F-4G Wild Weasel can be employed in a counter-air role as a penetration strike force escort, as an independent hunter-killer force, or as a standoff defense suppression force. We are updating the Wild Weasel systems so that the force can defeat the advanced threat radars being deployed now and through the 1990s. The APR-38 Radar Warning and Attack System is the backbone of the F-4G Wild Weasel. To update this mid-1970's design, we are increasing the capacity of the on-board computer, increasing receiver frequency range, and increasing system processing speed. These updates will allow the Wild Weasel aircraft to defeat increasingly complex radar signals in a denser signal environment. With these updates, we will also be able to fully exploit the capabilities of the High Speed Anti-Radiation Missile (HARM).

b. STATUS: Phase I of the update (increased computer capacity) began DOT&E/IOT&E in April 1985. Results look good and we expect to make a production decision in March 1986. We will begin deliveries and field installation of the phase I computers in Fiscal Year 1987 with an Initial Operational Capability (IOC) planned for September 1987. We completed circuit design feasibility of all critical components for Phase II (new receiver for increased frequency coverage and capability in a denser signal environment) and started fabricating the prototype units. Phase II was delayed due to vendor problems and receiver design miniaturization efforts. In Fiscal Year 1986, we will conduct receiver group airworthiness qualification and reliability testing, low frequency synthesizer airworthiness qualification, and complete software programming in preparation for flight test. We begin Phase II DT&E/IOT&E in July 1987 with testing continuing into Fiscal Year 1988. We will procure Phase II equipment beginning in Fiscal Year 1988 with IOC occurring in Fiscal Year 1990.

*F-4G WILD WEASEL*

In the Wild Weasel request, we have also included funds to conduct concept evaluation/risk reduction efforts in support of a follow-on Wild Weasel. This effort will determine the optimum approach to accomplishing the Suppression of Enemy Air Defense mission in the future.

### 6. EF-111 Tactical Jamming System Update

a. MISSION: The EF-111 Raven provides tactical jamming of early warning, acquisition, and ground control intercept radars in support of United States and Allied tactical strike operations. The EF-111 Tactical Jamming System denies enemy command and control centers the necessary range, azimuth, and altitude information used to cue their interceptors, surface-to-air missiles and antiaircraft artillery. The Raven can either accompany the strike force or act as a standoff jammer.

b. STATUS: The present EF-111 jamming suite was baselined in 1974. The update to counter Soviet advances since then will incorporate a new encoder, a new computer, a MIL-STD-1553B data bus, two reprogrammable exciters, and a new band 7/8 antenna. We are also making software changes to improve management of system power to concentrate the jamming signal on the radars of interest. Our update efforts are being closely coordinated with the Navy so that our efforts and their efforts to update the EA-6B jamming suite are not duplicative and provide synergistic results for both programs. In October 1984 we awarded a firm fixed price development contract with prepriced production options. In Fiscal Year 1986 we will fabricate full scale development kits and integrate them into test aircraft. The first kit delivery will be in May. We will also begin DT&E/IOT&E which will be completed in Fiscal Year 1987. We expect to make a production decision in Fiscal Year 1988.

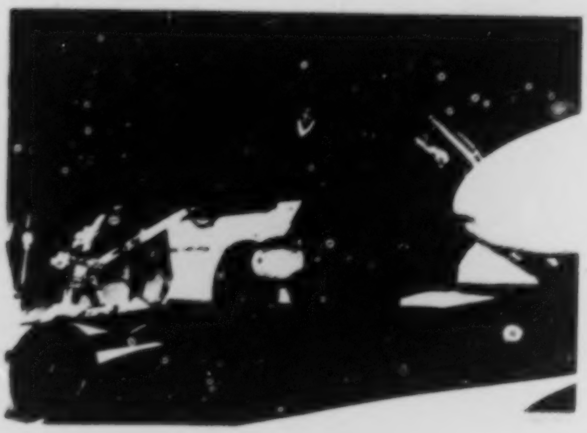
*EF-111 RAVEN*

7. Electronic Countermeasures Pods

a. MISSION: Electronic Countermeasures (ECM) pods provide a self protection capability for tactical aircraft which because of space, power, or cooling limitations or prohibitive retrofit costs, lack an internal countermeasures system. These aircraft include the A-7, the A-10, the F-16A/B/D, and the F-4. Our current inventory of pods includes ALQ-131 Block I & II pods, ALQ-119 pods (and the upgraded ALQ-119 pods). Continuous advances in Soviet air defense capabilities force us to upgrade/replace our inventory. By equipping tactical aircraft with these pods we can enhance their survivability. We also then will be able to use our limited, dedicated jamming asset, the EF-111 Raven, more efficiently.

b. STATUS: We are acquiring the ALQ-131 pods with improved reliability, maintainability, and performance. This pod gives the F-16A (and F-16C aircraft until the Airborne Self Protection Jammer (ASPJ) is available) a self-protection capability. During Fiscal Year 1985 we pursued Very High Speed Integrated Circuits technology applications in ALQ-131 components which were in various design stages.

During Fiscal Year 1986, we will begin Qualification Test and Evaluation of an upgraded ALQ-119 pod. We are currently accepting delivery of the first 70 systems. These modification kits are installed by both contractor and Air Force depot personnel. We will begin Qualification Operational Test and Evaluation in Fiscal Year 1986.



*ALQ-131 POD MOUNTED ON F-16*

8. Protective Systems

a. MISSION: This program develops new and improved self-protection equipment for Air Force strategic and F/FB-111 aircraft. This equipment includes infrared, optical, and electronic countermeasures and improved dispenser systems. This program maintains and updates computer threat simulation programs for evaluation of electronic warfare equipment. Funds are also used to keep our antenna test ranges current. We will concentrate on the F/FB-111 related activity.

b. STATUS: We are upgrading the F/FB/EF-111 aircraft countermeasures system for accurate and optimum use of chaff and flares. We are also developing an improved tail warning system for accurate detection of air-to-air and surface-to-air missiles. We plan to complete full scale development and make a production decision on the ALE-40 dispenser in Fiscal Year 1986. We should begin flight testing in Fiscal Year 1987.

9. Tactical Protective Systems

a. MISSION: This program develops new and improved self-protection electronic warfare equipment for tactical strike, air superiority, airlift and reconnaissance aircraft. We are currently working on systems for the F-15, F-16, A-10, F-4, special operations and airlift aircraft. These updates will provide effective aircrew warning and countermeasures to protect against sophisticated airborne and surface-to-air threats.

b. STATUS: For the F-15 aircraft we are upgrading its self-protection suite, the Tactical Electronic Warfare System (TEWS). The TEWS includes a radar warning receiver (ALR-56), an internal countermeasures system, an electronic warfare warning system, and a countermeasures dispenser. During Fiscal Year 1985, we conducted ground testing and developmental flight testing of individual systems and began TEWS integration. Since November 1984, production line F-15 C/D aircraft are equipped with Group A provisions for the ALE-45 Countermeasures Dispenser (CMD), ALR-56C and ALQ-135. In Fiscal Year 1986, we will begin full-up hardware/software development integration and testing. In Fiscal Year 1987, we will complete IOT&E of the TEWS and make a low-rate initial production decision. We also expect to deliver the prototype TEWS intermediate level support system.

For the F-16, we are developing a threat adaptive countermeasures dispenser, the ALE-47. In addition to being reprogrammable, the ALE-47 CMD interacts with the aircraft's Radar Warning and Jamming Systems. The interaction of these systems provides improved protection for the aircraft. We fielded two competing prototype ALE-47 C MDs. During Fiscal Year 1987, we will begin F-16/ALE-47 CMD integration. In Fiscal Year 1989, we plan to conduct DT&E and IOT&E and make a production decision in November 1989. We expect first production deliveries in July 1990. We will begin development of a pyrophoric flare (an expendable countermeasure capable of igniting spontaneously in the air, for use against infrared missiles) sized for the F-16.

For the A-10 self-protection suite, we are tailoring systems designed for other aircraft such as the ALQ-131 pods and the ALE-47 CMD system. Our primary activity is developing a pyrophoric flare sized for the A-10. We demonstrated the concept's feasibility in Fiscal Year 1985. During Fiscal Year 1986 we will conduct critical design review, ground and flight testing of a prototype flare. We expect to complete development and flight testing by August 1987 and make a production decision shortly thereafter. ALE-47 CMD tailoring should begin in Fiscal Year 1988 and complete in Fiscal Year 1990. Similar types of projects are underway for other fighter and special operations aircraft.

### 10. Airborne Self Protection Jammer

a. **MISSION**: The Airborne Self Protection Jammer (ASPJ) (AN/ALQ-165) will increase the survivability of our tactical aircraft (USAF F-16C, Navy F-14, F/A-18, A-6E, AV-8B) when confronted by modern, diversified, radar controlled weapon systems. ASPJ is a joint AF/Navy development program for an internally mounted electronic countermeasures system. The Navy is the lead service. Both services share equally in funding the common development efforts and pay the total costs for each applicable aircraft integration effort.

b. **STATUS**: In Fiscal Year 1985, we delivered test articles, began reliability demonstration testing, F-16/ASPJ integration and Development Test and Evaluation (DT&E). During Fiscal Year 1986, we will complete necessary milestones so that the production verification decision can be made in July 1986. DT&E will be completed in January 1987 to enable a joint Navy/Air Force Systems Acquisition Review Council (NSARC/AFSARC) limited production decision to be made in February 1987. In Fiscal Year 1987, we will complete environmental and Air Force Electronic Warfare Evaluation Simulator Initial Operational Test & Evaluation testing and begin IOT&E flight tests. We should make our decision for joint, full scale production in March 1988. We plan a total production run of over 2200 systems with over 1200 for Air Force aircraft.

In an effort to further commonality, we are looking at installing ASPJ in systems other than the F-16C. The ASPJ is a candidate in the open competition for the updated Electronic Countermeasures (ECM) system in the F/FB/EF-111 fleet. We are also investigating the advisability of competing a pod version of ASPJ as our next generation ECM pod.

## F. Theater Nuclear Forces

### BACKGROUND

1. Rationale: The destructiveness of modern nuclear weapons makes it imperative that we prevent a nuclear confrontation. Over the last decade the Soviets undertook a massive force buildup while our posture remained essentially static. This inaction coupled with the numerical superiority of Warsaw Pact conventional forces lowered the nuclear threshold. We were left without a credible theater defense option other than strategic nuclear force intervention. In 1979 the NATO alliance formally adopted a dual track approach to restoring a credible defense option Our request in the Fiscal Year 1987 budget continues to support that decision.

2. Threat: The Soviets have deployed over 400 SS-20 mobile nuclear missile launchers. Each missile carries three warheads. The SS-20 is capable of on and off road operation which greatly enhances its survivability. Modified versions are being tested. They are expected to have greater occuracy than the present force.

3. Ground Launched Cruise Missile

a. MISSION: The Ground Launched Cruise Missile (GLCM) counters the modernization of Soviet Long-Range Intermediate Nuclear Forces, particularly SS-20s and BACKFIRE bombers. The GLCM is a highly survivable system with enough range to reach targets in the Western military districts of the Soviet Union. The GLCM helps deter a combined Warsaw Pact/Soviet force which has numerical superiority in both conventional and theater nuclear forces.

b. STATUS: The Air Force accepted program management responsibility for the GLCM on September 4, 1985. Formerly, the GLCM was managed by the Joint Cruise Missile Program Office. The GLCM development program is winding down. During Fiscal Year 1985, we pressed forward with development and nuclear certification of Full Operational Capability (FOC) software for the operational flight system and the Data Transport Device production system. We successfully completed Electromagnetic Pulse testing of the launch equipment. In Fiscal Year 1986, we will complete FOC software development and nuclear certification for the weapons control system and missile procedures trainer. We will also implement material improvements resulting from reliability/maintainability analyses. During Fiscal Year 1986, we will complete these improvements, establish a final system baseline, and complete development of a plug-in Operational Test Launch Payload which will permit operational missile testing without first disassembling the missile.

*GROUND LAUNCHED CRUISE MISSILE*

## G. Chemical Forces

### BACKGROUND

1. **Rationale**: In any conventional conflict, chemical weapons if employed, could significantly influence the final outcome. Our objectives in chemical warfare are to be able to effectively retaliate and limit our vulnerability with the use of personal protective systems.

2. **Threat**: The Soviets have incorporated the ability to function in the chemical environment with all their weapons systems. They consider chemical warfare one of the strengths of their forces and maintain a considerable chemical warfare advantage over the U.S. and NATO Alliance. Although we would like to eliminate all chemical weapons, our arms control negotiators have not made any substantial progress toward concluding a comprehensive treaty to ban the weapons.

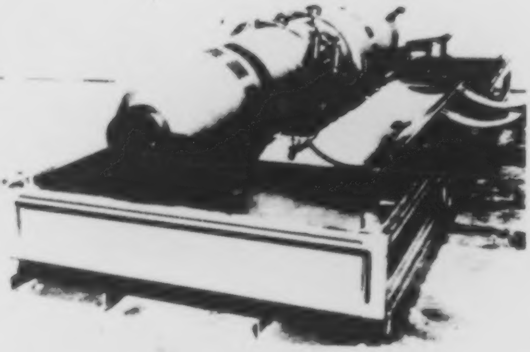
3. **Weapons**: Since our current stockpile is no longer a credible deterrent, we must demonstrate our commitment to restore this capacity. The Joint Chiefs believe that a modern chemical weapons capability is a critical part of this country's deterrent efforts. The Binary Chemical Weapon program is the key effort in supporting our negotiators.

4. **Protective Systems**: Of course offensive capability is only part of our chemical warfare deterrent capability. We must also protect our troops against the effects of chemical agents. We have fielded personal protective equipment - mask, hood, special suit, gloves and boots - however, it is cumbersome, fatiguing, and limits the effectiveness of our people. Tasks which are difficult to perform under ideal conditions are impossible in a chemical environment. To preserve our combat capability, we must provide not only better individual protective equipment, but also collective shelters where our troops can eat, rest, and perform maintenance in an uncontaminated environment. We must also provide equipment to detect and warn of agent presence and decontaminate our personnel and their equipment.

## Fiscal Year 1987 Programs

### 5. Binary Chemical Weapon

a. MISSION: The binary chemical weapon (Bigeye) provides a flexible, safe, chemical retaliatory capability. These weapons contain two nonlethal components one of which is inserted into the bomb body just prior to uploading onto the aircraft. After the bomb is released from the aircraft the two components are mixed forming the lethal chemical agent. Binary chemical weapons are less hazardous to maintain, stockpile, and transport. They have none of the dangers inherent in the unitary weapon. Our current unitary stockpile is very old and is hazardous to maintain and store.

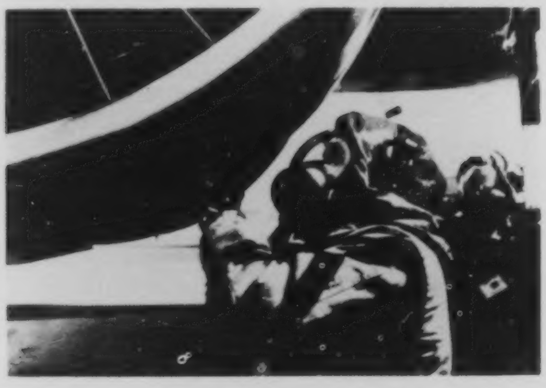


*BINARY CHEMICAL WEAPON*

b. STATUS: In conjunction with the Navy, the USAF is conducting an Initial Operational Test and Evaluation (IOT&E) of the Bigeye chemical weapon. These tests are proving the ability of Bigeye to fill the retaliatory capability void. The IOT&E results will be used to support a limited production decision which is scheduled for mid Fiscal Year 1986. In anticipation of a favorable decision, our Fiscal Year 1987 request contains funds to support this production decision.

### 6. Chemical/Biological Defense Equipment

a. MISSION: We must develop and acquire systems which will allow our forces to sustain combat capability in a chemical/biological environment. We must provide systems to detect, warn against, protect and decontaminate personnel and equipment. Collective protection systems will provide a chemical-free environment for rest and relief and improve performance of personnel in protective clothing. A new generation of individual protective equipment will overcome the shortfalls of current protective gear. These shortfalls include induced heat stress, restricted movement, loss of vision and loss of communications. Detection and warning will provide timely indication of attack as well as to signal an all clear when the chemical agent is no longer a threat. These systems will minimize the amount of time our troops need to wear protective clothing. The Air Force is lead service for aircrew unique individual protective equipment; however, we coordinate our efforts closely with our Army and Navy counterparts.

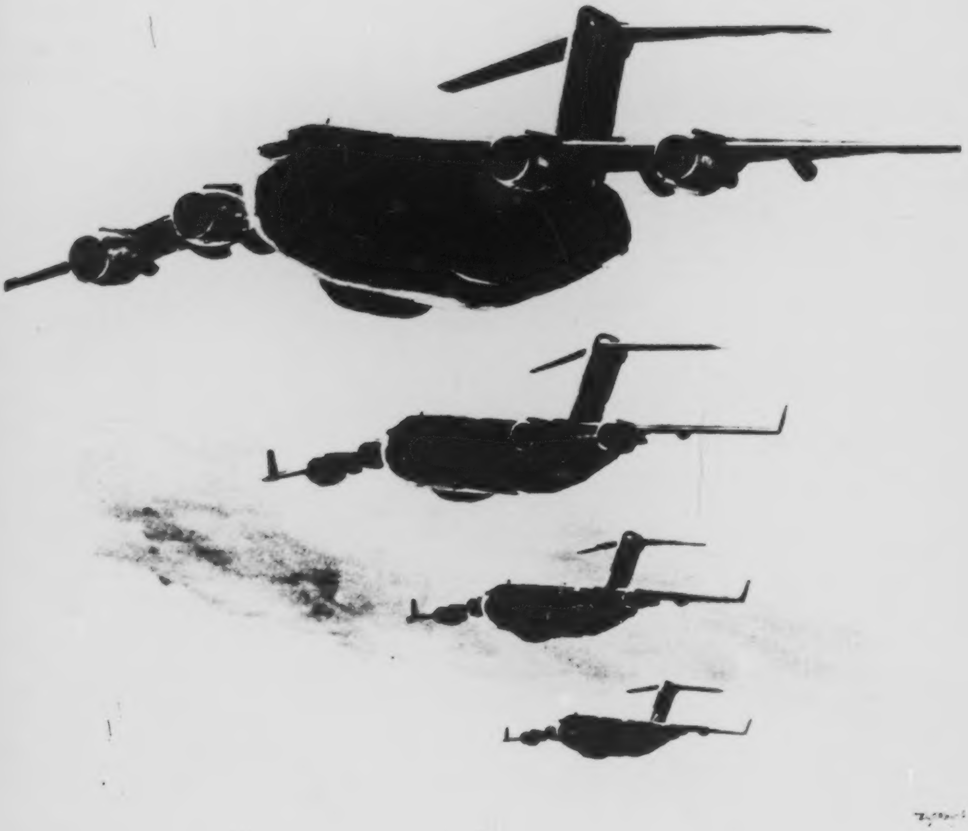


*MAINTENANCE CREW IN CHEMICAL/BIOLOGICAL SUITS*

b. STATUS: During Fiscal Year 1985 we successfully operated six prototypes of the Survivable Collective Protection System (SCPS-2) during the SALTY DEMO exercise in Europe. We also continued development of a set of transportable shelters. We will continue the development activities of these transportable shelters through Fiscal Year 1987. We will continue production of the SCPS-2 in Fiscal Year 1987.

In the individual protection area, work continues on the Aircrew Eye-Respiratory Protection System, the impermeable suit for ground crews and aircrew chemical protective ensembles. In Fiscal Year 1987, we will complete testing and begin production of the aircrew eye-respiratory protection system and complete testing of the aircrew ensemble. We will begin fielding the improved MCU-21P ground mask in Fiscal Year 1987.

Chemical agent detection and warning requirements will receive increased emphasis in Fiscal Year 1986 with initial production of the Surface Contamination Monitor. Then in Fiscal Year 1987 we will begin procurement of the Chemical Agent Monitor, a simplified, light weight unit for use by our airlift forces. We will also begin efforts to develop an integrated chemical detection and warning system. In Fiscal Years 1986 and 1987, equipment decontamination research and development efforts will accelerate. We will work jointly with the Army Chemical Research and Development Center to develop a fixed site avionics equipment decontamination unit based on a Freon solvent. This will improve our ability to conduct sustained operations when repair of aircraft avionics is required.



**C-17s IN FORMATION**
**Artist's Concept**

# IX. FORCE PROJECTION

## A. Objectives

The United States must be able to project combat forces worldwide in order to protect its vital interests, deter aggression, or limit potential conflicts. Today's world situation and the delicate balance of power which exists in many regions requires us to be ready on a moment's notice to deploy adequate forces based on the situation. The primary objective of force projection is to get adequate personnel and equipment to the right place at the right time. Proper and timely use of force projection can make the difference in controlling a situation or conflict at a low level of intensity or even deescalating it versus increasing hostility to a higher and more dangerous level.

## B. Airlift

### BACKGROUND

1. Rationale: Airlift is one part of the mobility triad along with sealift and prepositioning. While each has benefits and deficiencies, it is the proper utilization of all three together that provides the greatest amount of force structure to meet the threat. Mobility forces provide the link between force structure and combat capability.

Airlift is essential because it is the only element of mobility which has the responsiveness to meet the critical demands in the early days of a conflict before sealift can become effective. It also provides the link between prepositioned material and the personnel needed to make the combat force complete. Without an adequate airlift capability, our ability to project combat forces would be significantly degraded and we would be unable to meet our extensive global commitments.

Inter and intratheater airlift shortfalls have been documented since 1974 in 18 major studies. The one accepted as the benchmark and upon which we have based our long-term intertheater airlift capability goal is the 1981 Congressionally Mandated Mobility Study. The study analyzed four worldwide scenarios and determined what million ton-mile per day (MTM/D) intertheater capability would be needed to meet the requirements. The study recommended adding 20 MTM/D, of which half should be outsized, to the Air Force's projected 1986 capability of 46 MTM/D. It must be noted that the 66 MTM/D (46 plus 20) goal was a fiscally constrained recommendation and did not meet any of the four scenario intertheater lift requirements. It does represent increased force projection capability to address force projection requirements and is attainable within reasonable fiscal guidelines.

2. Threat: The Soviet capability to project combat forces has been steadily increasing and is expected to continue in the future. The recent unveiling of their C-5 type airlifter, "The Condor", is evidence of their commitment to increasing airlift capability and provides them with the ability to move large, outsize combat equipment over long ranges. Additionally, terrorist activity around the world is increasing and places an even greater demand on our ability to employ

the correct force at the right time. Our geographic location places a premium on the ability to quickly respond to hostilities in Europe, the Middle East, and the Far East. A rapid and sufficient airlift capability could prevent substantial losses and avoid an escalation of hostilities.

3. Current Systems: The airlift mission is currently performed by a combination of C-5, C-141, KC-10, Civil Reserve Air Fleet (CRAF), C-130, and Operational Support Airlift (C-12/C-21)/Special Air Mission (C-20) aircraft. These resources are operated in active duty, active/associate reserve, and air reserve force (Air Force Reserve and Air National Guard) units based around the world. The CRAF program is comprised of civil passenger, cargo, and cargo convertible aircraft that are operated by commercial airlines and can be called up in various stages during certain contingency/emergency situations.

In 1983, we began a modernization effort which addressed the need to increase capability and modernize the force structure. The C-5B, CRAF enhancement, CT-39 and C-140 replacement programs were initiated. The KC-10 program was expanded and low level development of the C-17 continued.

In Fiscal Year 1986, three of these programs were completed. The CT-39 fleet has been replaced on a one-for-one basis with 80 C-21s (Lear 35) and 40 C-12s under a lease program. This replacement is complete and requested Fiscal Year 1987 funding is for Operations and Maintenance money to manage the lease/contractor support contract. Final procurement of 11 total C-20s (Gulfstream III) was completed in Fiscal Year 1986 to replace the C-140 fleet with final delivery in Fiscal Year 1987. The CRAF enhancement program was also finished with funding of 19 total B-747 cargo convertible modifications. Fiscal Year 1987 will be the last year of KC-10 and C-5B procurement.

These acquisitions along with other enhancement/modification programs (C-5A/C-130 wing mod, communication and navigation upgrades, etc.) formed our overall near term improvement program. We worked to enhance those aircraft we already have and acquired new systems that would be available at the earliest possible date and at the lowest technical risk. The following chart summarizes the number of our current airlift forces operated by the active, reserve, and civil reserve forces.

## *U.S. AIRLIFT FORCES*

| Military Aircraft (PAA) | | Civil Reserve Air Fleet | |
|---|---|---|---|
| Type | Number** | Type | Number** |
| | (Active/Reserve) | Domestic | 37 |
| C-5 | 63/8 | Alaskan | 15 |
| C-141 | 234/0* | Short-range International (cargo) | 20 |
| C-130 | 216/302 | Short-range International (pax) | 6 |
| KC-10 | 38/0* | Long-range International (cargo) | 63 |
| | | Long-range International (pax) | 225 |

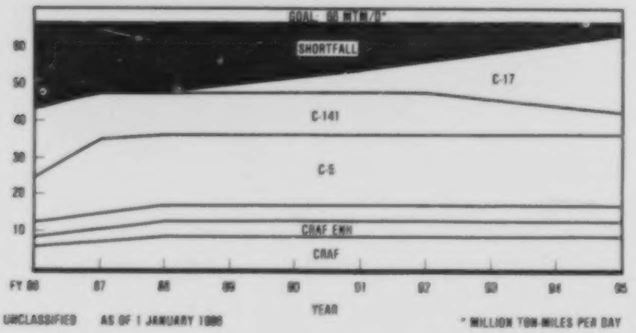
* C-5, C-141, and KC-10s are jointly operated by Active and Associate Reserve Units. Eight C-5s were transferred o the Air Reserve Forces in 1985. C-141s will begin to transfer in Fiscal Year 1986 and continue through Fiscal Year 1987.

** Full Activation

(As of 1 January 1986)

4. Future Systems: The Air Force program in the future is primarily comprised of two parts. First, we will continue enhancement of current systems through upgrade or modification. The other part of our long-term program is development and procurement of the C-17. Deficiencies in the airlift system, manpower constraints, high reliability and maintainability, and affordability were primary considerations used in our decision to buy the C-17. The multi-role capability and low life cycle cost of the C-17 made it the best choice to meet overall airlift requirements, counter the threat and provide a credible force projection capability well into the 21st century.

5. Airlift Master Plan: In 1983, the Air Force completed work and published the USAF Airlift Master Plan. This document laid out a roadmap and justification for pursuing the acquisition strategy mentioned previously. It accepted our near term enhancements (KC-10, C-5B and CRAF) as a baseline and examined what was the best approach to meet long-term objectives for increased capability and force structure modernization. The plan concluded that procurement of the C-17 best met the objectives and at the lowest life cycle cost. The chart below outlines our plan for meeting the 66 million ton-mile per day requirement.



*U.S. INTERTHEATER CARGO AIRLIFT CAPABILITY PLAN*

## Fiscal Year 1987 PROGRAMS

### 6. C-5B

a. MISSION: The C-5A is the largest free-world aircraft in operation today and performs the intertheater or strategic airlift mission. It augments the C-141 fleet in performing this mission and is our only airlifter capable of carrying outsize cargo and equipment. This equipment comprises most of the combat forces firepower items (self-propelled artillery, attack helicopters, fighting vehicles, tanks, large trucks/vans, etc.). The current fleet of C-5A aircraft provides nearly 30 percent of our total intertheater airlift capability. This will increase to nearly 40 percent with introduction of the C-5B and outsize airlift aircraft will increase 65 percent. The C-5B is critical to the U.S. meeting its near term objectives to increase intertheater airlift capacity and provide a viable force projection capability to protect our interests worldwide.

*C-5B GALAXY*

b. STATUS: The C-5B program is being executed under a firm fixed price contract awarded in December 1982. The initial award in Fiscal Year 1983 was for one aircraft with four annual options that run through Fiscal Year 1987. The Fiscal Year 1984 (4 aircraft) and Fiscal Year 1985 (8 aircraft) procurement contracts have been executed which brings total C-5B procurement to 13 aircraft. In Fiscal Year 1986, we plan to procure 16 more C-5Bs with the last procurement of 21 aircraft in Fiscal Year 1987. The first C-5B rolled out in July 1985 and first flight was conducted on September 10, 1985. A test program totalling some 66 hours was performed on the first aircraft. This aircraft was delivered to the Air Force on December 28, 1985. The last delivery will be completed in early Fiscal Year 1989. The 50 new C-5B aircraft will be added to our current fleet of 77 C-5A aircraft for a total C-5 force structure of 127 aircraft. As new C-5Bs enter the inventory, C-5As will be transferring to Air Force Reserve and Air National Guard units. Eight C-5As have already been transferred, five to Kelly AFB Texas and three to Stewart Field New York.

7. C-17

a. MISSION: Acquisition of the C-17 will bring our last increment of intertheater airlift capability to the minimum level recommended in the 1981 Congressionally Mandated Mobility Study of 66 million ton-miles per day. Because of the C-17's unique ability to perform the intratheater or tactical airlift mission as well, we will get our first tactical outsize airland and airdrop capability. The ability to deliver outsize cargo/equipment within the theater of operations is critical to meeting the need for increased battlefield mobility and airlifting our modernizing combat forces. The C-17 will be the first airlift aircraft capable of performing the full spectrum of airlift missions, from intercontinental movement of personnel and cargo to low altitude parachute extraction of outsize equipment in the forward battle area. This multi-role capability provides our theater commanders and operations planners tremendous flexibility in employment and allows them to utilize the C-17 where the demand is highest, either intertheater or intratheater. With designed in reliability and survivability, the C-17 will be our most capable, survivable and lowest life cycle cost airlifter for the capability provided.

*C-17*

b. STATUS: Since the 1981 competitive source selection and contract award in July 1982, the C-17 program has been conducting low level research and development activities pending the formal decision to begin full scale development (FSD). Wind tunnel testing, system and airframe mock-ups, structural testing, logistics support analysis, and extensive development engineering have been ongoing. With Congressional approval of the Fiscal Year 1985 budget request and February 1985 DoD approval to begin FSD, the program has been gradually increasing the level of development effort. Preliminary design, reviews, subcontractor and vendor identification, and engine testing are underway. The Fiscal Year 1986 program will continue this increasing engineering effort and expand work in the support areas. The whole effort is directed toward critical design review, tool design, and fabrication, and initial aircraft long lead funding in Fiscal Year 1987. Procurement begins in Fiscal Year 1988 with an initial operational capability in Fiscal Year 1992. The Air Force plans to procure 210 C-17s from Fiscal Year 1988 to Fiscal Year 1998 and deploy the aircraft in active duty, active/associate reserve, and organic reserve and guard units based in the U.S.

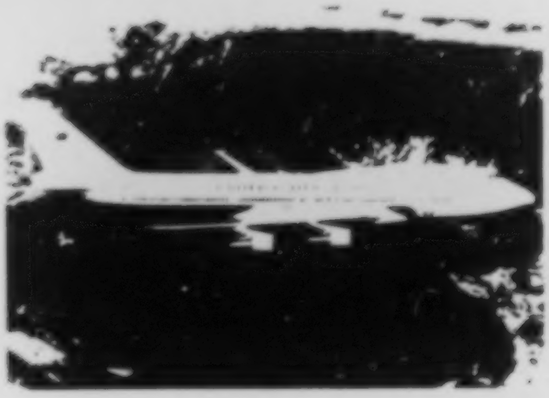
### 8. Air Force One

a. MISSION: The two existing Presidential aircraft, designated Air Force One when the President is on board, are 13 and 23 years old respectively. They are becoming increasingly difficult to maintain and support because their commercial airline counterpart, the Boeing 707, is being phased out of service. In addition to being difficult to support, the aircraft do not meet Federal Aviation

Administration noise standards nor do they meet requirements for communications, range, performance, or payload. In this latter area, space is needed for an on-board medical treatment facility as well as a work area for members of the National Security Council. Also, the working conditions for the President and his staff need to be improved. The replacement aircraft will be two new wide body FAA certified aircraft with three engines or more. The contenders are the McDonnell Douglas DC-10-30 and the Boeing 747 SP and 300 models. These aircraft will be electromagnetic pulse hardened to insure safe flight and communications connectivity and will have self contained steps and electrical/air-conditioning units to permit operation with less ground support equipment.

DC-10

B-747



AIR FORCE ONE CANDIDATES

b. STATUS: The Air Force One Replacement Program was initiated in August 1985. Competition is critical to this program in terms of reducing costs and maintaining public confidence in Department of Defense procurement. When we analyzed the market, we determined that only two American manufacturers were producing suitable aircraft and one of them, McDonnell Douglas, would be unable to compete unless a contract would be awarded in April-May 1986. This was due to the projected closing down of their production line. Therefore, in order to maintain competition, it is imperative that we use the Fiscal Year 1986 funds prior to April 1986 in order to award the contract. The remaining money, is requested in the Fiscal Year 1987 President's Budget. The first aircraft should be delivered in the late 1988 timeframe with the second aircraft delivered in Spring 1989.

## C. Aerial Refueling

### BACKGROUND

1. Rationale: The KC-135A was designed in the 1950's and built from 1955 through 1964. In the early 1960's, the Strategic Air Command was the only major user of inflight refueling tankers, and the KC-135 force was sized to match the strategic bomber force. During the Vietnam era, the tactical forces also became dependent on air refueling to extend combat range and combat effectiveness. Moreover, air refueling was used to cut down lengthy deployment time as tactical forces were moved into various theatres of operations. Political changes evident during the early 1970's made air refueling even more important in wartime planning. Without access to enroute staging bases, our ability to project forces or resupply allies demanded the use of inflight refueling. Over the past 25 years, then, air refueling has changed from a tactic used primarily by the strategic bomber force into a tactic used by virtually every Air Force aircraft and some Naval combat aircraft. Air refueling is critical to the successful deployment, employment, and redeployment of US forces. During the late 1960's and 1970's there was no increase in the tanker force, but there was a sevenfold increase in Air Force, Navy and allied aircraft demanding air refueling support. Consequently, a significant tanker shortfall developed. In response to this shortfall, the KC-10 program was developed to add new tanker aircraft to enhance mobility operations while modification programs to the KC-135A fleet were developed to increase strategic tanker offload capability.

### Fiscal Year 1987 PROGRAMS

2. KC-10A Extender

a. MISSION: The KC-10A adds significant air refueling and cargo capacity to the Air Force inventory. The "Extender" greatly improves our ability to support worldwide contingency operations while reducing our dependency on foreign operating bases. Strategic airlifter cargo loads can be significantly increased and delivery time for mission-critical cargo can be reduced because of the huge fuel offload capability and the long range of the KC-10A. For tactical fighter deployments, the KC-10A provides enroute air refueling to the fighter aircraft while carrying support equipment and personnel to ensure adequate support of the deployed fighters. The result is that fighters will be ready to fight almost immediately. With a separate air refueling boom and hose-reel system for probe-and-drogue refueling, the KC-10 is compatible with all USAF, Navy and allied aircraft. Likewise, in an "all-cargo" mode, the KC-10 provides a significant addition to our airlift capability.

*KC-10 EXTENDER*

b. **STATUS**: Procurement of our planned force of 60 KC-10As will be completed in Fiscal Year 1987 with the purchase of the last eight aircraft. In October 1985, we opened the third KC-10A base at Seymour-Johnson AFB, North Carolina. With 36 aircraft delivered through the end of Fiscal Year 1985, we are using the KC-10 to its full advantage. As an example of the aircraft's capability, consider this representative mission. Two KC-10As deployed six F-15 airplanes from Okinawa, Japan to Eglin AFB, Florida on a non-stop 14.7 hour mission. The KC-10s also carried 72,000 pounds of support personnel and cargo to ensure the F-15s were fully mission ready on landing. This 7046-mile mission required the KC-10As to receive fuel from two KC-135s---two launched from Japan and two launched from Minot AFB, North Dakota. In all, two KC-10As and four KC-135s teamed up to replace 11 KC-135s, one EC-135, and two C-141s. The KC-10A program is on track.

### 3. KC-135R Modernization Program

a. **MISSION**: The KC-135 remains the nation's primary strategic aerial refueling tanker. The "Stratotanker" extends the mission duration and "war-fighting" effectiveness of all USAF combat aircraft by providing global inflight refueling during deployment, employment, and redeployment operations. Moreover, the KC-135 is an integral part of the Single Integrated Operational Plan (SIOP) providing mission critical fuel to the strategic bomber force. Inflight refueling enhances combat operations by permitting planning flexibility and increasing combat time and mission range. The KC-135R modernization program provides a significant 50% increase in fuel available for transfer when compared to the basic KC-135A airplane. This increased offload is due largely to the new CFM56 high by-pass turbofan engines added in the KC-135R modernization. In addition to the increased thrust, decreased fuel consumption and decreased noise and air pollution provided by the CFM56 engines, the modernization program updates 25 aircraft systems including the landing gear, electrical system, and the auxiliary power units. This total modernization provides a highly reliable and maintainable aircraft that will continue to meet the nation's refueling requirements well beyond the year 2000.

*KC-135R STRATOTANKER*

b. STATUS: Through Fiscal Year 1986, we have funded 145 KC-135R modernizations. The first Strategic Air Command unit to complete conversion was at McConnell Air Force Base, Kansas. The conversion was completed with superb results, and the modernized aircraft have performed exactly as planned. We have started conversion of the second unit at Ellsworth Air Force Base, South Dakota. We have already started to reap the benefits of the modernization program. During the operational test program, for example, one KC-135R departed Loring Air Force Base, Maine and flew to Scotland. There, the KC-135R rendezvoused with and air-refueled an E-3A. This fuel permitted the E-3A to continue to the United States while the KC-135R landed in Scotland with several hours of fuel reserves. One KC-135R replaced two KC-135As on this mission. The Fiscal Year 1987 re-engining program will continue production of KC-135R modernization kits.

### 4. KC-135E Re-engining Program

a. MISSION: As an interim solution to specific Air Reserve Force problems with KC-135A performance, noise, and pollution the KC-135E, also helps to ease the tanker shortfall by providing a 20 percent increase in offload capability. The KC-135E replaces the old J-57 engines of the KC-135A with turbofan JT-3D engines removed from Boeing 707 airliners being retired from service. The "donor" 707 also provides some modification components required for the re-engining.

b. STATUS: Funds for this re-engining program have been added by the Congress over the last several years; 128 Air Reserve Force KC-135A aircraft were funded through Fiscal Year 1985 for retrofit with the 707's JT-3D engines.

## D. Special Operations Forces

### BACKGROUND

1. Rationale: Special Operations Forces (SOF) must be able to conduct a wide range of missions at all levels of conflict in order to provide the United States with unique options where the use of large conventional forces would be premature, inappropriate, or infeasible. These forces are typically used to resolve crises and to terminate conflicts that are still at relatively low levels. The primary missions for which the Department of Defense maintains a Special Operations Force capability include military/paramilitary training, interdiction raids, personnel recovery, counter-terrorist operations. and, only rarely, covert activities.

Air Force SOF primarily provide airlift and selective firepower support for Army Special Forces, Army Rangers, and Naval Special Warfare Units, and in conjunction with those forces conduct or support collective security, unconventional warfare, direct action/ strike missions, psychological operations (PSYOPS) and contingency missions. Since most SOF missions require secrecy, surprise, and low probability of detection or interception, Air Force SOF assets must be comprised of equipment and personnel specially configured and trained to conduct unusual, short-notice, politically sensitive, low visibility, and difficult to detect operations.

2. Threat: The Soviet Union and its surrogates have both encouraged and supported worldwide revolutions as a way of achieving their objectives without direct confrontation with the Free World. These low intensity conflicts will likely be the most pervasive threat to Free World security for the remainder of this century. US Special Operations Forces provide the capability to respond to this threat and a wide range of crises in a flexible manner.

3. Current Systems: Although most aerospace forces may be used in special operations, the Air Force organizes, trains and equips specific units to conduct special operations as their primary mission. These units are equipped with MC-130, AC-130, EC-130, HH-53, and CH-3 aircraft. We organize,train, and employ these forces to provide flexible, specialized capabilities throughout the spectrum of conflict. Selected C-130 and C-141 airlift forces are also specially trained and equipped to augment the core SOF. Combat rescue forces, equipped with HC-130, UH-60, HH-53, H-3 and H-1 aircraft, also augment the SOF.

4. Future Systems: In order to upgrade the current SOF capability the Air Force is procuring additional MC-130s and AC-130s, and is participating with the US Navy in development of the V-22 (JVX) aircraft in order to acquire the CV-22A version for SOF missions. Twenty-one new MC-130H Combat Talon II aircraft will supplement the current fleet of 14 MC-130E Combat Talon I aircraft to reduce the long-range infiltration/exfiltration/ resupply shortfall. Twelve new AC-130 gunship aircraft will allow replacement of the aging and increasingly difficult to support A-model gunships and will increase the fleet's deployability and survivability. Eighty new CV-22A will provide a long-range exfiltration capability not currently possessed and will complement the MC-130 inflitration and resupply capability.

## Fiscal Year 1987 PROGRAMS

### 5. CV-22A (JVX)

a. MISSION: The CV-22A is the linchpin of Air Force Special Operations Forces (SOF) in the 1990s. It is the key development program for obtaining the long-range capability needed to insert and extract SOF teams. The CV-22A bridges the performance gap between conventional helicopters and fixed wing aircraft by combining medium speed cruise efficiency with vertical takeoff and landing. It replaces the HH-53 and blends with the MC-130H to provide the full spectrum of capability required to perform the worldwide SOF mission.

*CV-22A*

b. STATUS: The Navy-led V-22 program has nearly completed the preliminary design phase in which the team of Bell Helicopter and Boeing Vertol conducted over 4500 hours of wind tunnel and simulation testing, completed numerous trade studies to identify cost and weight drivers, and developed cost estimates for full scale development scheduled to begin in early Fiscal Year 1986. The Navy is responsible for funding all airframe and engine developments and their mission unique systems. The Air Force is funding SOF mission unique development and its operational test and evaluation. First flight is set for February 1988 and Air Force deliveries start in Fiscal Year 1993 with initial operational capability (six aircraft) scheduled for Fiscal Year 1994.

### 6. MC-130H

a. MISSION: The Combat Talon II aircraft will be capable of long-range penetration into politically denied/sensitive, defended areas to infiltrate, resupply, or exfiltrate forces or equipment during adverse weather conditions, day or night. It will conduct low profile operations supporting U.S. or allied services unconventional warfare forces throughout the conflict spectrum from low intensity conflict to general war. Combat Talon II will perform a broad range of complementary missions using airdrop or airland of personnel and equipment, aerial refueling to extend range and increase surprise, and terrain followina radar to allow terrain masking from enemy threats.

*MC-130H COMBAT TALON II*

b. **STATUS**: Lockheed is providing C-130H airframes modified with aerial refueling capabability, a high-speed low-level aerial delivery system, explosion and fire suppressed fuel systems, and special lighting equipment. IBM has developed an integrated avionics system to provide terrain following, terrain avoidance radar, precision navigation, secure communications, and electronic counter measures capability. Five aircraft are already on contract funded by Fiscal Year 1982 through Fiscal Year 1985 appropriations. Two aircraft are planned for Fiscal Year 1986. First flight is now scheduled for January 1987, and the initial operational unit will receive the first five aircraft in March 1988 upon completion of the qualification and operational flight test and evaluation.

### 7. AC-130

a. **MISSION**: The AC-130 gunship provides Special Operations Forces (SOF) with precision fire support and is a long range attack aircraft with extensive loiter time over the target coupled with an immediate capability to detect, identify, record and destroy targets. Although the gunship's primary mission is special operations/unconventional warfare, its unique capabilities permit the AC-130 to perform the conventional roles of close air support, armed reconnaisance and base defense. The gunship's multimission capability was successfully demostrated during the recent Grenada contingency operation where the AC-130 interdicted key enemy communication sites, destroyed enemy antiaircraft gun positions, provided close air support for the invasion force, and performed around the clock surveillance of the battlefield.

*AC-130*

b. STATUS: The intent of the acquisition program is to allow replacement of the 10 aging and difficult to support AC-130A gunships for 12 new, reliable, and maintainable aircraft. To prepare for a Fiscal Year 1987 new start, the Air Force released a Request For Information (RFI) to industry on October 18, 1985 asking for configuration proposals, cost estimates, and delivery schedules. The Air Force will use the responses to the RFI to draft a Request For Proposal with a target release date of June 1986. The source selection is tentatively scheduled for completion by December 15, 1986 with award of contract before the end of 1986. As in the MC-130H program, the Air Force will procure the C-130 airframes from the Georgia Lockheed Aircraft Corporation and compete the avionics and weapon systems integration. The initial aircraft will be a prototype with testing completed by 1990. Initial deliveries will begin in 1991 with full operational capability in early 1993.

*ARNOLD ENGINEERING AND DEVELOPMENT CENTER*
*TENNESSEE*

# X. TEST AND EVALUATION

## A. Improved Capability for Development Test and Evaluation

1. **MISSION**: With increased emphasis on testing, there is a need to provide the capability to adequately test and evaluate current and future weapons and support systems. This program acquires and installs new test range and instrumentation systems for developmental test. These improvement and modernization projects are installed at our major test facilities: The Arnold Engineering and Development Center in Tennessee, the Air Force Armament Division in Florida, the Air Force Flight Test Center in California, and the 4950th Test Wing in Ohio. Major new starts include the HAVE LINK program and the Cruise Missile Mission Control Aircraft (CMMCA) programs. All activities are coordinated through the DoD Major Range and Test Facility Base Planning Function.

2. **STATUS**: The HAVE LINK program responds to OSD direction to protect weapon system design information and test data as it is being transmitted from test systems on DoD ranges. In Fiscal Year 1987 we will address the most urgent vulnerabilities and fund the quick fixes having the highest payoffs in terms of operations and communications security. As vulnerabilities are identified we will develop fixes.

The CMMCA will augment the present cruise missile test support fleet. The two CMMCA aircraft when operational will support approximately 80 cruise missile test missions per year. This projected workload is beyond the capability of the present test support fleet. This national resource will support all West Coast and Canadian cruise missile testing. These aircraft will provide telemetry support, mission control functions, radar safety chase, and flight following capabilities. These aircraft will permit testing in instrument meterological conditions, not presently possible, allowing for optimum use of range times. In the second quarter of Fiscal Year 1987, we will release the request for proposal to convert two inventory C-18 aircraft to the CMMCA configuration. We expect contract award in the third quarter. The first aircraft will be operational in Fiscal Year 1989 and the second in Fiscal Year 1990.

Another major activity in Fiscal Year 1987 is the application of Global Position System (GPS) technology to provide Time-Space Positioning Information. Under this Tri-Service effort, we plan to miniaturize and configure GPS receivers and translators to interface with test and training vehicles. When operational at test and training ranges, the system will improve accuracy and coverage of range instrumentation, reduce the number of ground-based tracking sites, and enhance inter-range compatibility. In Fiscal Year 1985 we successfully flew a demonstration pod to test receivers, antennas, and packaging concept. Full scale development will be during Fiscal Year 1986. Following a successful critical design review we will award a contract for production prototype hardware for the Air Force's Gulf Drone Control Upgrade System and the Army's Mobile Automated Field Instrumentation System. In Fiscal Year 1987 and Fiscal Year 1988 we will test the prototype systems. We expect to begin low-rate, initial production during the first quarter of Fiscal Year 1988.

Numerous smaller efforts are also included in this program. All activities are geared toward upgrading data processing, telemetry and test instrumentation systems, and upgrade of our advanced range instrumentation aircraft.

## B. Test and Evaluation Support

1. MISSION: This program provides the resources for the test support technical functions at Air Force Systems Command (AFSC) test facilities. These facilities are part of the Department of Defense Major Range and Test Facility Base (MRTFB). These facilities support Air Force, other Services, government agencies, and commercial industry. Many capabilities at these facilities do not exist elsewhere. These test facilities are: the Arnold Engineering and Development Center, the Air Force Armament Division, the Air Force Flight Test Center, and the 4950th Test Wing.

2. STATUS: The Arnold Engineering and Development Center provides ground environment test support for aeronautical, missile and space programs utilizing wind tunnels, altitude rocket cells, aeroballistic ranges, altitude engine test cells, and space chambers. Programs supported include the F-15, F-16 ATF aircraft, F100/F110 engines, the Strategic Defense Initiative, Peacekeeper, Small ICBM, and the Space Shuttle. The Aeropropulsion Test Facility and the Captive Trajectory Support System will be operational in early Fiscal Year 1986. The Fiscal Year 1987 funds provide the institutional portion for the Center's technical support mission.

The Armament Division (AD) at Eglin Air Force Base, Florida is the prime Air Force organization charged with nonnuclear armament development. AD is the focal point for integrating munitions onto aircraft. This Division conducts and supports weapon effectiveness testing, electronic combat testing, and electronic surveillance and control testing. AD conducts more than 550 test projects per year. One of the more unique facilities is the McKinley Climatic Laboratory at Eglin Air Force Base, Florida. We can perform environmental tests on a complete aircraft. In Fiscal Year 1987, Armament Division's 50 instrumented ranges and 43 aircraft will support nearly 625 different programs.

The Air Force Flight Test Center at Edwards Air Force Base, California conducts and supports development test and evaluation and operational test and evaluation of aircraft and aircraft systems, aerospace research vehicles such as the X-29, cruise missiles and provides support for the Space Shuttle. The flight test center operates several highly instrumented ranges and the USAF Test Pilot School. The center has firm customer forecasts for Fiscal Year 1987 which show continuation of the testing surge that began in Fiscal Year 1984. Programs that will be supported include the B-1B, F-15E, LANTIRN, X-29A, ASAT, and the F-20. We will begin the Short Takeoff and Landing and Maneuvering Technology Program testing activities.

The 4950th Test Wing at Wright-Patterson AFB, Ohio performs flight tests of aircraft and airborne systems and supports space vehicle tracking with the Advanced Range Instrumentation Aircraft. The Test Wing can conduct full scale engineering evaluations, airborne instrumentation, and data reduction. The Test Wing's modification facilities accomplish Class II modifications to AFSC test aircraft. This facility is converting C-18 (used commercial Boeing 707 aircraft) to the EC-18B ARIA configuration. During Fiscal Year 1987, the Test Wing will continue to support DoD and NASA missile and space programs such as the Trident, the Space Shuttle, and Pershing II, and will become involved with programs such as the Mark XV Identification Friend or Foe system, the Advanced Tactical Radar, and the Joint Surveillance and Target Attack Radar System. The tempo is upbeat; the seven aircraft ARIA fleet alone will stage out of 13 overseas bases in support of NASA.

APPENDIX A

# TABLE I

## DEPARTMENT OF THE AIR FORCE
## FISCAL YEAR 1987 AIRCRAFT PROCUREMENT ESTIMATES*

(In Millions of Then Year Dollars)

|  | FISCAL YEAR ESTIMATES |  |  |  |
|---|---|---|---|---|
|  | 1986 |  | 1987 |  |
| **COMBAT AIRCRAFT** | QTY | $ | QTY | $ |
| B-1B (MYP) | 48 | 4952.9 | - | - |
| ACM Integration on B-1B | - | 96.0 | - | - |
| Air Defense Competition | 10 | 192.0 | 20 | 410.9 |
| F-15 E | 48† | 1888.9 | 48 | 1894.3 |
| F-16 C/D (MYP) | 180 | 3006.1 | 216 | 3493.9 |
| KC-10A | 12 | 416.4 | 8 | 104.4 |
| AC-130A | 0 | 0 | - | 18.2 |
| MC-130H | 2 | 130.8 | 5 | 244.8 |
| Drug Interdiction | 1 | 33.4 | - | - |
| **COMBAT SUPPORT AIRCRAFT** |  |  |  |  |
| C-5B Airlift Aircraft | 16 | 2048.8 | 21 | 1937.4 |
| C-17 | - | - | - | 217.3 |
| C-20A | 8 | 147.7 | - | - |
| Air Force One (VC-X) | 2 | 280.0 | - | 34.5 |
| Civil Air Patrol | 0 | - | 38 | 1.6 |
| TR-1/U-2 | 6 | 296.5 | 3 | 94.5 |
| **MODIFICATION OF IN-SERVICE AIRCRAFT** | - | 2885.3 | - | 3101.3 |
| **AIRCRAFT SPARES AND REPAIR PARTS** | - | 3811.1 | - | 3477.9 |
| **AIRCRAFT SUPPORT EQUIPMENT & FACILITIES** | - | 2844.6 | - | 4096.4 |
| Common Aerospace Ground Equipment | - | 535.5 | - | 321.4 |
| Other Production Charges | - | 2174.0 | - | 3685.5 |
| Industrial Responsiveness | - | 51.9 | - | 38.4 |
| War Consumables | - | 83.2 | - | 51.1 |
| **TOTAL AIR FORCE AIRCRAFT PROCUREMENT** | 333 | 23030.5 | 359 | 19127.4 |

* Based on Fiscal Year 1986 DoD Appropriations and Fiscal Year 1987 President's Budget, as of February 5, 1986.

† Includes 40 F-15 C/D Aircraft.

APPENDIX A

## TABLE II

### DEPARTMENT OF THE AIR FORCE
### FISCAL YEAR 1987 MISSILE PROCUREMENT ESTIMATES*
(In Millions of Then Year Dollars)

| | FISCAL YEAR | | | |
|---|---|---|---|---|
| | 1986 | | 1987 | |
| **BALLISTIC MISSILES** | QTY | $ | QTY | $ |
| Peacekeeper | 12 | 1676.0 | 21 | 1418.1 |
| Replacement Equipment (Strategic) | - | 63.9 | - | 69.7 |
| **OTHER MISSLES** | | | | |
| Air Launch Cruise Missile | - | 32.6 | - | 12.4 |
| AIM-7M (Sparrow) | 497 | 77.9 | 379 | 64.9 |
| AIM-9M (Sidewinder) | 1650 | 76.9 | 1710 | 95.6 |
| AGM-130 | 5 | 19.0 | 51 | 26.6 |
| AGM-65D/G (Maverick) | 2600 | 407.9 | 4700 | 581.0 |
| AGM-88A (HARM) | 1450 | 414.8 | 2130 | 493.4 |
| AIM-120 (AMRAAM) | 15 | 209.0 | 260 | 746.5 |
| Ground Launched Cruise Missile | 95 | 515.2 | 76 | 133.2 |
| Stinger | - | - | - | 1.7 |
| Target Drones | - | 34.3 | - | 19.6 |
| Other Missile Programs | - | 666.6 | - | 810.2 |
| Industrial Facilities | - | 20.6 | - | 14.5 |
| Replacement Equipment | - | 13.8 | - | 17.2 |
| **MODIFICATION OF IN-SERVICE MISSILES** | | 155.6 | | 146.5 |
| **SPARES AND REPAIR PARTS** | | 441.7 | | 334.2 |
| **SPACE AND OTHER SUPPORT** | | | | |
| Spaceborne Equip (COMSEC) | - | 34.3 | - | 61.9 |
| Global Positioning System (MYP) | 9 | 197.4 | 8 | 129.7 |
| Space Shuttle Operations | - | 240.7 | - | 59.1 |
| Defense Meteorological Sat Prog | - | 41.0 | - | 19.4 |
| Defense Support Program | - | 124.1 | - | 358.5 |
| Defense Satellite Comm System (MYP) | 2 | 141.1 | 2 | 122.7 |
| AF Satellite Communications System | 1 | 32.6 | - | - |
| Space Boosters | - | 120.2 | 1 | 282.7 |
| Space Defense System | - | - | - | 28.5 |
| Special Programs | - | 2717.5 | - | 2896.2 |
| Space Shuttle | - | 21.0 | - | - |
| **TOTAL AIR FORCE MISSILE PROCUREMENT** | | 8317.0 | | 8982.4 |

* Based on Fiscal Year 1986 DoD Appropriations and Fiscal Year 1987 President's Budget, as of February 5, 1986.

APPENDIX A

## TABLE III

### DEPARTMENT OF THE AIR FORCE
### FISCAL YEAR 1987 OTHER PROCUREMENT ESTIMATES*
(In Millions of Then Year Dollars)

| | FISCAL YEAR | |
|---|---|---|
| | 1986 | 1987 |
| MUNITIONS & ASSOCIATED EQUIPMENT | 1199.9 | 1546.2 |
| VEHICULAR EQUIPMENT | 304.8 | 331.8 |
| ELECTRONICS & TELECOMMUNICATIONS EQUIPMENT | 2493.9 | 3183.1 |
| OTHER BASE MAINTENANCE & SUPPPORT EQUIPMENT | 4569.5 | 5839.2 |
| TOTAL AIR FORCE OTHER PROCUREMENT | 8568.1 | 10900.3 |

* Based on Fiscal Year 1986 DoD Appropriations and Fiscal Year 1987 President's Budget, as of February 5, 1986.

APPENDIX A

## TABLE IV

### DEPARTMENT OF THE AIR FORCE
### FISCAL YEAR 1987 RESEARCH, DEVELOPMENT TEST AND EVALUATION ESTIMATES*

(In Millions of Then Year Dollars)

| | FISCAL YEAR | |
|---|---|---|
| | 1986 | 1987 |
| TECHNOLOGY BASE | 811.5 | 848.3 |
| ADVANCED TECHNOLOGY DEVELOPMENT | 665.1 | 784.3 |
| STRATEGIC PROGRAMS | 5338.1 | 7044.3 |
| TACTICAL PROGRAMS | 2742.5 | 3896.8 |
| INTELLIGENCE & COMMUNICATIONS | 2243.7 | 2559.6 |
| DEFENSE WIDE MISSION SUPPORT | 1986.4 | 2119.4 |
| TOTAL RESEARCH, DEVELOPMENT, TEST AND EVALUATION | 13787.4 | 17252.2 |

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* Based on Fiscal Year 1986 DoD Appropriations and Fiscal Year 1987 President's Budget, as of February 5, 1986.

# TABLE V

## DEPARTMENT OF THE AIR FORCE
## FISCAL YEAR 1987 RESEARCH, DEVELOPMENT TEST AND EVALUATION ESTIMATES*

(In Millions of Then Year Dollars)

| Program Element Number | TITLES | FISCAL YEAR | |
|---|---|---|---|
| | | 1986 | 1987 |
| | **TECHNOLOGY BASE** | | |
| 61101F | In-House Laboratory Independent Research | 16.0 | 17.5 |
| 61102F | Defense Research Sciences | 206.1 | 212.6 |
| 61103F | University Research Initiative | 6.3 | 12.5 |
| 62101F | Geophysics | 39.4 | 40.6 |
| 62102F | Materials | 53.2 | 57.5 |
| 62201F | Aerospace Flight Dynamics | 68.7 | 70.3 |
| 62202F | Aerospace Biotechnology | 48.1 | 53.4 |
| 62203F | Aerospace Propulsion | 63.3 | 65.6 |
| 62204F | Aerospace Avionics/VHSIC | 71.2 | 67.8 |
| 62205F | Training/Simulation Technololgy | 25.4 | 26.8 |
| 62206F | Civil & Engineering Environment QA | 9.2 | 5.4 |
| 62302F | Rocket Propulsion | 40.1 | 41.9 |
| 62601F | Advanced Weapons | 36.2 | 37.1 |
| 62602F | Conventional Munitions | 41.2 | 49.9 |
| 62702F | Command, Control, Communications | 78.3 | 79.7 |
| 62703F | Personnel Utilization Technology | 8.6 | 9.8 |
| | **ADVANCED TECHNOLOGY DEVELOPMENT** | | |
| 63106F | Logistics R&D Requirements | 9.5 | 19.1 |
| 63109F | Integrated EW SystemAdvanced Development | 43.9 | 60.1 |
| 63202F | Aircraft Propulsion Subsystem Integration | 26.7 | 30.2 |
| 63203F | Advanced Avionics for Aircraft | 21.0 | 49.8 |
| 63205F | Flight Vehicle Technology | 19.4 | 27.6 |
| 63208F | Recon Sensors/Processing Technology | 5.8 | 6.1 |
| 63211F | Aerospace Structures and Materials | 18.1 | 31.5 |
| 63215F | Aviation Turbine Fuel Technology | 8.0 | 10.4 |
| 63216F | Adv Turbine Engine Gas Generator | 26.9 | 27.8 |
| 63217F | Weapon System Power | 1.2 | 3.5 |
| 63226F | DOD Common Prog Language (ADA) | 7.3 | 6.9 |
| 63227F | Advanced Simulator Technology | 4.3 | 5.1 |
| 63231F | Crew Systems Technology | 11.2 | 15.9 |
| 63244F | Aircraft Non-nuclear Survivability | 3.2 | 2.5 |
| 63245F | Advanced Fighter Technology Integration | 19.2 | 30.7 |
| 63250F | Lincoln Laboratory | 23.0 | 26.5 |
| 63253F | Advanced Systems Integration Demonstration | 0.0 | 9.4 |
| 63259F | Cartog Applications-Tac & Strat System | 1.4 | 1.7 |
| 63269F | National Aerospace Plane Technology | 0.0 | 33.5 |

* Based on Fiscal Year 1986 DoD Appropriations and Fiscal Year 1987 President's Budget, as of February 5, 1986.

## APPENDIX B

| Program Element Number | TITLES | FISCAL YEAR 1986 | FISCAL YEAR 1987 |
|---|---|---|---|
| 63302F | Space and Rocket Propulsion | 3.3 | 12.9 |
| 63363F | Hypervelocity Missile | 10.5 | 9.6 |
| 63401F | Advanced Spacecraft Technology | 6.8 | 14.4 |
| 63410F | Space Sys Environ Interactions Technology | 3.9 | 8.5 |
| 63424F | Curise Missile Surveillance Technology | 11.3 | 16.9 |
| 63452F | Very High Speed Integrated Circuits | 202.0 | 132.9 |
| 63601F | Conventional Weapons | 24.9 | 30.9 |
| 63605F | Advanced Radiation Technology | 23.4 | 23.6 |
| 63704F | Manpower and Personnel Sys Technology | 2.1 | 2.4 |
| 63707F | Weather Systems | 3.4 | 3.7 |
| 63723F | Civil/Environmental Engineering Technology | 13.7 | 13.7 |
| 63726F | Fiber Optics Development | 3.4 | 2.8 |
| 63727F | Advanced Communications Technology | 4.8 | 1.9 |
| 63728F | Advanced Computer Technology | 7.3 | 10.5 |
| 63743F | Electro-Optical Warfare | 13.9 | 53.4 |
| 63745F | Chemical Warfare Defense | 4.9 | 5.1 |
| 63750F | Counter/Countermeasures-Advanced Develop | 13.1 | 7.6 |
| 63751F | Training Systems Technology | 2.3 | 2.4 |
| 63752F | DOD Software Engineering Institute | 11.4 | 9.5 |
| 63789F | $C^3$ Advanced Development | 15.9 | 23.0 |
|  | **STRATEGIC PROGRAMS** |  |  |
| 11142F | KC-135 Squadrons | 0.9 | 3.9 |
| 11213F | Minuteman Squadrons | 5.5 | 67.5 |
| 11312F | PACCS and WWABNCP System EC-135 | 4.0 | 14.8 |
| 11316F | SAC Communications | 7.4 | 0.6 |
| 12310F | NCMC-TW/AA Systems | 51.1 | 32.9 |
| 12311F | NCMC-Space Defense Systems | 56.5 | 41.3 |
| 12313F | Ballistic Msl Tac Warning/Atk Assess Sys | 2.1 | 3.1 |
| 12325F | Joint Surveillance System | 2.0 | 3.5 |
| 12411F | Surveill Radar Stations/Sites | 19.7 | 25.0 |
| 12412F | DEW Radar Stations | 39.9 | 14.4 |
| 12417F | Over-the-Horizon Radar | 65.7 | 33.9 |
| 12423F | Ballistic Missile Early Warning System | 12.6 | 16.2 |
| 12424F | Spacetrack | 9.4 | 16.5 |
| 12431F | Defense Support Program | 77.5 | 138.2 |
| 12432F | SLBM Radar Warning Systems | 8.0 | 19.8 |
| 12433F | Integ Operational Nudets Detect System | 20.0 | 31.3 |
| 12436F | $C^2$ Process/Display System | 14.4 | 27.0 |
| 33131F | Minimum Essential Emergency Comm Network | 99.5 | 92.5 |
| 33152F | WWMCCS Information System | 4.9 | 8.5 |
| 33154F | WWMCCS Information System-JPMO | 62.1 | 111.4 |
| 33601F | Milstar Satellite Comm. System (AF Terminals) | 124.3 | 298.5 |
| 33603F | Milstar Communications Satellite System | 336.9 | 493.4 |
| 41123F | Military Airlift Group (IF) | 19.5 | 9.0 |
| 63311F | Advanced Strategic Missile Systems | 159.8 | 176.9 |
| 63364F | Short-Range Attack Missile II | 34.1 | 164.7 |
| 63367F | Strategic Relocatable Target Capability | 0.0 | 1.0 |
| 63368F | Air Defense Battle Management Technology | 0.0 | 2.5 |

| Program Element Number | TITLES | FISCAL YEAR | |
|---|---|---|---|
| | | 1986 | 1987 |
| 63369F | Cruise Missile Engagement System Technology | 0.0 | 2.1 |
| 63716F | Atmospheric Surveillance Technology | 4.9 | 32.0 |
| 63735F | WWMCCS Architecture | 7.8 | 2.2 |
| 64226F | B-1B | 271.6 | 218.7 |
| 64234F | Common Strategic Rotary Launcher | 70.8 | 14.6 |
| 64312F | ICBM Modernization | 1442.3 | 2116.8 |
| 64326F | Strat Conventional Standoff Capability | 35.1 | 7.5 |
| 64361F | Air Launched Cruise Missile | 10.9 | 6.1 |
| 64406F | Space Defense System | 199.5 | 278.0 |
| 64711F | Systems Survivability (Nuclear Effects) | 7.7 | 13.5 |
| | **TACTICAL PROGRAMS** | | |
| 27129F | F-111 Squadrons | 47.3 | 35.2 |
| 27130F | F-15 Squadrons | 230.0 | 209.0 |
| 27133F | F-16 Squadrons | 66.3 | 81.3 |
| 27136F | F-4G Wild Weasel Squadrons | 35.7 | 38.7 |
| 27162F | Tactical AGM Missiles | 1.9 | 2.4 |
| 27215F | TR-1 Squadrons | 0.0 | 23.5 |
| 27217F | Follow-on Tac Recce Systems | 0.0 | 30.6 |
| 27247F | Air Force TENCAP | 0.2 | 0.1 |
| 27411F | Overseas Air Weapon Control System | 3.0 | 8.5 |
| 27412F | Tactical Air Control System | 14.6 | 19.3 |
| 27417F | Airborne Warning and Control System | 118.8 | 137.2 |
| 27423F | Advanced Communication Systems | 100.8 | 33.3 |
| 27431F | Tac Air Intelligence System Activities | 2.1 | 0.5 |
| 27435F | Tac Reconnaissance Imagery Exploitation | 7.5 | 0.8 |
| 27595F | Base Comm-Tac Air Forces | 0.9 | 3.2 |
| 28010F | Jt Tactical Comm Program (TRI-TAC) | 4.8 | 11.4 |
| 33605F | Satellite Communications Terminals | 4.8 | 4.6 |
| 35887F | Electromagnetic Combat Intelligence Support | 1.6 | 1.8 |
| 41840F | MAC Command/Control System | 7.7 | 22.7 |
| 44011F | Special Operations Forces | 9.7 | 66.5 |
| 52610F | A-7 Squardons (ANG) | 0.0 | 4.5 |
| 63230F | Advanced Tactical Fighter (ATF) | 164.6 | 294.1 |
| 63239F | Unmanned Air Reconnaissance Vehicle | 9.7 | 3.9 |
| 63256F | Jt Service Adv Vert Lift Actf (CV-22A) | 2.4 | 4.9 |
| 63307F | Airbase Survivability and Recovery | 4.9 | 7.1 |
| 63320F | Low Cost Seeker | 17.1 | 14.8 |
| 63609F | Millimeter Wave Seekers | 18.6 | 14.2 |
| 63714F | DOD Physical Security Eq-Exterior | 1.0 | 1.0 |
| 63717F | Technical On-Site Inspection (TOSI) | 0.0 | 9.9 |
| 63742F | Combat Identification Technology | 8.5 | 6.3 |
| 63749F | C$^3$CM Advanced Systems | 1.9 | 4.5 |
| 64201F | Acft Avionics Equipment Development | 28.4 | 25.1 |
| 64212F | Acft Equip Development | 8.5 | 4.9 |
| 64218F | Engine Model Derivative Program | 60.6 | 68.1 |
| 64219F | Integrated Digital Avionics | 8.0 | 13.4 |
| 74220F | EW Counter Response | 29.2 | 34.1 |

| Program Element Number | TITLES | FISCAL YEAR | |
|---|---|---|---|
| | | 1986 | 1987 |
| 64222F | Nuclear Weapons Support | 2.0 | 4.3 |
| 64223F | Alternate Fighter Engine | 32.5 | 109.4 |
| 64231F | C-17 Program | 372.8 | 612.3 |
| 64236F | Infrared Search and Track System | 23.1 | 34.8 |
| 64247F | Modular Automatic Test Equipment | 9.7 | 23.7 |
| 64249F | Night Precision Attack | 39.8 | 40.1 |
| 64268F | Acft Engine Component Improvement Program | 121.7 | 141.8 |
| 64313F | Next Generation Trainer | 52.8 | 10.8 |
| 64314F | Adv Med Range Air-to-Air Missile | 101.3 | 39.1 |
| 64315F | Advanced Short-Range Air-to-Air Missile | 0.0 | 0.4 |
| 64321F | Joint Tactical Fusion Program | 23.7 | 24.7 |
| 64327F | Hardened Target Munitions | 0.0 | 15.1 |
| 64362F | Ground Launched Cruise Missile | 0.7 | 7.4 |
| 64601F | Chemical/Biological Defense Equipment | 21.9 | 27.2 |
| 64602F | Armament Ordance Development | 17.1 | 29.8 |
| 64604F | Submunitions Development | 37.9 | 4.9 |
| 64607F | Wide-Area Anti-Armor Munition | 12.2 | 15.1 |
| 64617F | Air Base Survivability and Recovery | 19.4 | 21.3 |
| 64703F | Aeromedical Systems Development | 7.8 | 9.3 |
| 64706F | Life Support System | 15.3 | 12.4 |
| 64708F | Other Operational Equipment | 17.5 | 14.5 |
| 64710F | Reconnaissance Equipment | 7.6 | 9.5 |
| 64715F | DOD Physical Security Eq-Exterior | 15.3 | 18.5 |
| 64724F | Tac $C^3$ Countermeasures | 29.7 | 24.6 |
| 64725F | Combat Identification Systems | 12.8 | 12.0 |
| 64733F | Surface Defense Suppression | 29.2 | 44.1 |
| 64737F | Airborne Self-Protection Jammer | 5.0 | 10.1 |
| 64738F | Protective Systems | 50.1 | 92.7 |
| 64739F | Tactical Protective System | 43.8 | 94.9 |
| 64740F | Computer Resources Management Technology | 11.7 | 13.0 |
| 64742F | Precision Location Strike System | 61.5 | 26.6 |
| 64750F | Intelligence Equipment | 13.1 | 10.4 |
| 64756F | Side Looking Airborne Radar (SLAR) | 23.4 | 19.7 |
| 64770F | Joint STARS | 0.0 | 355.7 |
| 64779F | Jt Interoperability Tactical $C^2$ System | 8.9 | 9.9 |
| | **INTELLIGENCE AND COMMUNICATIONS** | | |
| 32053F | NMCS-Wide Support-Communications | 0.0 | 2.0 |
| 33110F | Defense Satellite Communication System | 6.8 | 14.0 |
| 33126F | Long Haul Communications (DCS) | 11.2 | 5.6 |
| 33128F | Interservice Agency Auto Msg Proc Exchange | 30.6 | 54.6 |
| 33144F | Electromagnetic Compatibility Anal Center | 7.3 | 7.7 |
| 35114F | Traffic Cntrl/Approach/Landing System | 23.9 | 18.6 |
| 35164F | NAVSTAR GPS (User Eq) | 28.0 | 45.0 |
| 35165F | NAVSTAR GPS (Space/Grnd Segment) | 44.4 | 44.4 |
| 63260F | Intelligence Advance Development | 0.0 | 6.1 |
| 63431F | Space Communications | 41.9 | 35.8 |
| 84733F | General Intelligence Skill Training | 5.2 | 4.8 |

## APPENDIX B

| Program Element Number | TITLES | FISCAL YEAR 1986 | FISCAL YEAR 1987 |
|---|---|---|---|
| | DEFENSE WIDE MISSION SUPPORT | | |
| 35110F | Satellite Control Facility | 71.3 | 91.7 |
| 35119F | Space Boosters | 215.9 | 138.7 |
| 35130F | Consolidated Space Operations Center | 85.2 | 93.7 |
| 35160F | Def Meteorological Satellite Program | 54.9 | 63.8 |
| 35171F | Space Shuttle Operations | 75.4 | 175.9 |
| 63248F | Concept Development | 2.0 | 3.2 |
| 63402F | Space Test Program | 66.7 | 73.7 |
| 63438F | Satellite Systems Survivability | 4.2 | 5.4 |
| 63790F | NATO Cooperative Research and Development | 25.0 | 49.2 |
| 64211F | Adv Aerial Target Development | 13.1 | 11.1 |
| 64227F | Flight Simulator Development | 128.4 | 102.7 |
| 64237F | Vrbl Stab In-Flt Sim Test Acft (VISTA) | 0.4 | 8.7 |
| 64609F | R&M Maturation/Technology Insertion | 6.6 | 18.0 |
| 64707F | Weather Systems | 7.9 | 8.4 |
| 64735F | Range Improvement | 52.6 | 64.6 |
| 64747F | Electromagnetic Radiation Test Facility | 3.3 | 5.7 |
| 64755F | Improved Capability for RDT&E | 45.2 | 89.5 |
| 65101F | Project Air Force | 18.2 | 18.3 |
| 65304F | Acquisition/Command Support - TELECOM | 6.6 | 11.0 |
| 65306F | Ranch Hand II Epidemiology Study | 4.7 | 7.4 |
| 65708F | Nav/Radar/Sled Track Test Support | 20.7 | 25.9 |
| 65806F | Acquisition and Command Support | 356.5 | 285.1 |
| 65807F | Test and Evaluation Support | 426.7 | 304.2 |
| 65808F | Advanced Systems Engineering/Plan | 17.0 | 23.1 |
| 65863F | RDT&E Aircraft Support | 55.5 | 62.4 |
| 65872F | Productivity Improvement | 2.9 | 5.1 |
| 65874F | Product Performance Agmt Cntr (PPAC) | 0.0 | 1.2 |
| 65894F | Real Property Maintenance-RDT&E | 0.0 | 140.3 |
| 65896F | Base Operations (RDT&E) | 0.0 | 110.3 |
| 71112F | Inventory Control Point Operations | 2.9 | 4.8 |
| 72207F | Depot Maintenance (IF) | 0.0 | 0.5 |
| 78011F | Industrial Preparedness | 62.9 | 83.6 |
| 78026F | Product/Reliable/Avail/Maintain Program | 14.0 | 31.4 |
| A1004F | International Activities | 3.0 | 2.7 |

# GLOSSARY

| | |
|---|---|
| AACE | Aircraft Alerting Communications Electromagnetic Pulse |
| AASM | Advanced Air-to-Surface Missile |
| ACM | Advanced Cruise Missile |
| ADP | Automated Data ProcessingAFB |
| AFB | Air Force Base |
| AFE | Alternate Fighter Engine |
| AFEWES | Air Force Electronic Warfare Evaluation Simulator |
| AFMAG | Air Force Management Analysis Group |
| AFSARC | Air Force Systems Acquisition Review Council |
| AFSATCOM | Air Force Satellite Communications |
| AFSF | Air Force Stock Fund |
| AFTI | Advanced Fighter Technology Integration |
| AIRS | Advanced Intertial Reference Sphere |
| ALCM | Air Launched Cruise Missile |
| AMRAAM | Advanced Medium Range Air-to-Air Missile |
| AMST | Advanced Military Spaceflight Technology |
| AN/MPN-XX | Rapidly Deployable Air Traffic Control System |
| ASARS | Advanced Synthetic Aperture Airborne Radar Systems |
| ASAS | All Source Analysis System |
| ASAT | Antisatellite |
| ASMS | Advanced Strategic Missile System |
| ASPJ | Airborne Self-Protection Jammer |
| ASRAAM | Advanced Short-Range Air-to-Air Missile |
| ATARS | Advanced Tactical Air Reconnaissance System |
| ATB | Advanced Technology Bomber |
| ATF | Advanced Tactical Fighter |
| AWACS | Airborne Warning and Control System |
| AWS | Advanced Warning System |
| BLSS | Base Level Self-Sufficiency Spares |
| BMD | Ballistic Missile Defense |
| BMEWS | Ballistic Missile Early Warning System |
| BKEP | Boosted Kinetic Energy Penetrator |
| $C^2$ | Automated Command and Control |
| $C^3$ | Command, Control and Communications |
| CADIN | Continental Air Defense Integration North |
| CEM | Combined Effects Munition |
| CMD | Countermeasures Dispenser |
| CONUS | Continental United States |
| CRAF | Civil Reserve Air Fleet |
| CSD | Critical Subsystems Development |
| CSOC | Consolidated Space Operations Center |
| CSRL | Common Strategic Rotary Launcher |
| DAACM | Direct Airfield Attack Combined Munition |
| DCS | Defense Communications System (Long Haul Communications) |
| DEW | Distant Early Warning |
| DMSP | Defense Meteorological Satellite Program |
| DOD | Department of Defense |

| | |
|---|---|
| DSCS | Defense Satellite Communications System |
| DSP | Defense Support Program |
| DSARC | Defense System Acquisition Review Council |
| DT&E | Development, Test and Evaluation |
| ECCM | Electronic Counter-Countermeasures |
| ECM | Electronic Countermeasures |
| EHF | Extremely High Frequency |
| EJS | Enhanced JTIDS System |
| ELINT | Electronic Intelligence |
| ELV | Expendable Launch Vehicle |
| EMDP | Engine Model Derivative Program |
| EMP | Electromagnetic Pulse |
| ENSUE | Enemy Situation Correlation Element |
| FAA | Federal Aviation Administration |
| FLIR | Forward Looking Infrared |
| FRG | Federal Republic of Germany |
| FSD | Full Scale Development |
| FWETE | Foreign Weapons, Equipment and Technology Evaluation |
| GEODSS | Ground-based Electro-Optical Deep Space Surveillance |
| GLCM | Ground Launched Cruise Missile |
| GPS | Global Positioning System |
| GWEN | Ground Wave Emergency Network |
| HARM | High Speed Anti-Radiation Missile |
| HF | High Frequency |
| ICBM | Intercontinental Ballistic Missile |
| IIR | Imaging Infrared |
| IMIP | Industrial Modernization Incentive Program |
| IOC | Initial Operational Capability |
| IONDS | Integrated Operational Nuclear Detonation Detection System |
| IOT&E | Initial Operational Test and Evaluation |
| IPB | Industrial Base Program |
| IUS | Inertial Upper Stage |
| JAFE | Joint Advanced Fighter Engine |
| Joint STARS | Joint Surveillance and Target Attack Radar System |
| JSC | Johnson Space Center |
| JTACMS | Joint Tactical Missile System |
| JTFP | Joint Tactical Fusion Program |
| JTIDS | Joint Tactical Information Distribution System |
| JVX | Joint Service Vertical Lift Aircraft Development Program |
| LANTIRN | Low Altitude Navigation and Targeting Infrared System for Night |
| LF | Low Frequency |
| LLLGB | Low Level Laser Guided Bomb |
| MAC | Military Airlift Command |
| MANTECH | Manufacturing Technology |

| | |
|---|---|
| MCE | Modular Control Equipment |
| MEECN | Minimum Essential Emergency Communications Network |
| MIL-STD | Military Standard |
| MLS | Microwave Landing Systems |
| MRT | Miniature Receive Terminal |
| MSE | Manned Spacecraft Engineer |
| MST | Missile Surveillance Technology |
| MTBF | Mean Time Between Failure |
| NASA | National Aeronautics and Space Administration |
| NATO | North Atlantic Treaty Organization |
| NCA | National Command Authority |
| NDS | Nuclear Detonation Detection System |
| NGT | Next Generation Trainer |
| NORAD | North American Aerospace Defense |
| NUDET | Nuclear Detonation |
| NWS | North Warning System |
| O&M | Operations and Maintenance |
| OFT | Operational Flight Trainer |
| OMG | Operational Maneuver Group |
| OSD | Office of Secretary of Defense |
| OTH-B | Over-the-Horizon-Backscatter |
| OWRM | Other War Reserve Materiel |
| PACBAR | Pacific Barrier Radar |
| PAM-D II | Payload Assist Modules-Delta Class II |
| PARCS | Perimeter Acquisition Radar Characterization System |
| PAVE PAWS | SLBM Radar Warning System |
| PBA | Production Base Analysis |
| PE | Program Element |
| PLSS | Precision Location Strike System |
| PIAS | PLSS Intelligence Augmentation System |
| POS | Peacetime Operating Stock |
| PPAC | Product Performance Agreement Center |
| PRAM | Productivity, Reliability, Availability, Maintainability |
| QSAS | Quick Start Auxiliary Power Unit |
| QT&E | Qualification Test and Evaluation |
| QOT&E | Qualification Operational Test and Evaluation |
| R&D | Research and Development |
| RDT&E | Research, Development, Test and Evaluation |
| RF | Radio Frequency |
| RFP | Request For Proposal |
| R&M | Reliability and Maintainability |
| SAC | Strategic Air Command |
| SACDIN | Strategic Air Command Digital Network |
| SBSS | Space Based Space Surveillance |
| SCF | Satellite Control Facility |
| SCSC | Strategic Conventional Standoff Capability |
| SDI | Strategic Defense Initiative |
| SDIO | Strategic Defense Initiative Organization |

| | |
|---|---|
| SDS | Satellite Data System |
| SHF | Super High Frequency |
| SINCGARS | Single Channel Ground and Airborne Radio System |
| SLAR | Side Looking Airborne Radar |
| SLBM | Submarine-Launched Ballistic Missile |
| SOF | Special Operations Forces |
| SRAM II | Short Range Attack Missile II |
| STC | Satellite Test Center |
| STP | Space Test Program |
| STS | Space Transportation System |
| TAC | Tactical Air Command |
| TACS | Tactical Air Control System |
| TACMS | Tactical Missile System |
| TARS | Tactical Air Reconnaissance System |
| TDMA | Time Division Multiple Access |
| TDRS | Tracking Data Relay Satellite |
| TEWS | Tactical Electronic Warfare System |
| TMD | Tactical Munitions Dispenser |
| TOA | Total Obligation Authority |
| TRACALS | Traffic Control and Landing System |
| TRI-TAC | Joint Tactical Communications |
| UARS | Unmanned Air Reconnaissance System |
| UHF | Ultra High Frequency |
| VHF | Very High Frequency |
| VHSIC | Very High Speed Integrated Circuits |
| VISTA | Variable Stability In-Flight Simulator Test Aircraft |
| VLF | Very Low Frequency |
| WAAM | Wide Area Antiarmor Munitions |
| WIS | WWMCCS Information System |
| WRM | War Reserve Materiel |
| WRSK | War Readiness Spares Kits |
| WWMCCS | Worldwide Military Command and Control System |

[Whereupon, at 12 p.m., the subcommittee recessed, to reconvene at 2 p.m., the same day.]

### AFTERNOON SESSION

**Mr. HERTEL** [presiding]. We will now resume the meeting. We have had our private session.

Dr. Cooper, you may proceed.

**Dr. COOPER.** We would like to convince you this afternoon that we do not have a commitment to inferiority as Mr. Battista has suggested.

We would like to start off with an overview of our technology-based programs, and to present that, we will have General Rankine, who has appeared before the committee before.

There are three particular efforts he would like to briefly talk about: Our manufacturing technology program, VHSIC, and the national aerospace plane.

**Mr. DICKINSON.** This is when we get into the commitment for mediocrity.

**Dr. COOPER.** Commitment to excellence.

## STATEMENT OF BRIG. GEN. ROBERT R. RANKINE, JR., USAF, SPECIAL ASSISTANT FOR SCIENCE AND TECHNOLOGY AND STRATEGIC DEFENSE INITIATIVE, DEPUTY CHIEF OF STAFF, RESEARCH, DEVELOPMENT AND ACQUISITION

### TOPICS

#### TECHNOLOGY MANAGEMENT IMPROVEMENTS

Important technology programs.—Some examples:
Very high speed integrated circuits [VHSIC].
Manufacturing technology; and
National aero-space plane.

**General RANKINE.** Mr. Chairman, I would like to cover some technology management improvements, and then I would to address three specific programs which are of interest to the Air Force and to the subcommittee; the Very High Speed Integrated Circuits Program manufacturing technology, and the national aero-space plane.

### AF SCIENCE AND TECHNOLOGY

Includes:

Research (budget activity category 1).—Basic research in universities, industry, and in-house.

Exploratory development (BAC 1).—Develop technologies of potential military value.

Laboratory O&M.

Advanced technology development (BAC 2).—
Evaluate technology in military environment;
Generic application; and
Technology transition.

And when we speak of science and technology in the Air Force, we are talking about budget activity categories 1 and 2. Ordinarily, these two together, basic research and exploratory development, constitute the tech base, but we believe it is very important to consider in conjunction with the technology base investment, the advanced technology development investment. The tech base produces science in the laboratories which has military applications, but until we demonstrate that science in the military environment, we cannot transition the technology into weapons systems, and so we try to manage the overall science and technology program in all three areas as a set.

### PHILOSOPHY OF RESTRUCTURE

Basic research (6.1) PEs basically unchanged.
Exploratory development (6.2) PEs basically unchanged [exception: AFHRL].
Results in one 6.2 per lab.
Goal of two advanced technology development PEs per lab.
"Component/Core" PE.
"Integration/demonstration" PE.

One of the initiatives that we have been working on for about a year was a restructuring of the present program element accounting system in order to give better visibility to both the Congress, and to the Air Force, for that matter. The chairman of this subcommittee sent us a memo back in October, to the Secretary of Defense, requesting that we not do that, because he saw it as a means for reducing the quality of the descriptive summaries.

Since that time, I have talked to Mr. Battista in December, and to Mr. Bayer in February, and hopefully convinced them that our intentions are not to disguise any of the technology work that is going on, but rather to present it a little more clearly.

And in order to show that to the committee, I will go through a couple of charts. The philosophy of our restructuring, the intention of which is management improvement, is to consolidate, particularly in the area of the 6.3 program elements, and consolidate it into two major program elements at each major laboratory; We wouldn't change the basic research 6.1, or reduce the 6.2 area, except to combine the two 6.2 program elements at the Human Resources Laboratory. Basically we would use a standard structure at each laboratory, having a component or core technology program element, and then having a program element for integrating technologies for demonstration purposes.

### CURRENT STATUS OF RESTRUCTIVE OF S&T PROGRAM ELEMENTS

[Implement with FY 88 President's Budget—Air Staff Proposal to AFSC]

| | FY 87 | FY 88 | Percentage change |
|---|---|---|---|
| Number of program elements | 60 | 42 | .30 |
| Number of descriptive summaries | 60 | 42 | .30 |
| Number of projects | 229 | 229 | 0 |

And we believe if we would implement that restructuring with the President's 1988 budget—we have not done that for 1987, because of the subcommittee chairman's letter—we would actually reduce the program elements by about 30 percent. We would not reduce the number of projects, but maintain the same number, and the descriptive summaries are written for each program element in detail at the project level, so we would not be withholding any information from the Congress that it does not now get.

### EXPECTED BENEFITS OF PE RESTRUCTURING

Reduced workload: Fewer packages to process, less need to create new PEs in future.

Improved clarity: Common structure for all laboratories; no multi-laboratory PEs.

Unobscured insight: Same number and content of projects; same detail at project level.

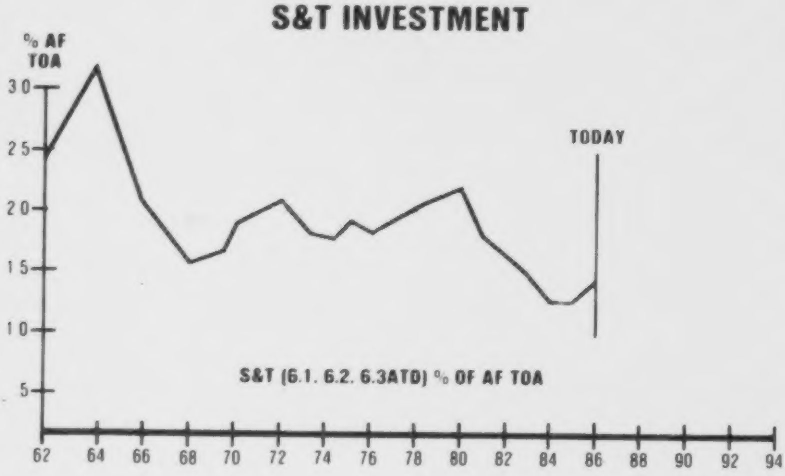
The benefit of that would be insofar as the Air Force is concerned, it would be a tremendous reduction in the workload for us, because through the annual process, we manage by program elements, and to reduce the number of program elements by 30 percent would accomplish a significant reduction in the workload in our annual managing of the budget and the technology accounts.

Also, we believe that we could kind of hold the line on the number of program elements that way, because by adopting a standard, there would be less of a need to adopt new program elements in the future. Additionally, it would give improved clarity to the Congress in what is going on in the science and technology program, because there would be a standard set of program elements for each lab, and you would know where to look for a particular technology.

Right now, we find that we have a program element going to a laboratory, and a project within there might be going to another laboratory, so it tends to confuse exactly where the money is going to be spent.

We are going to clean that up within this restructuring so all of the projects are at the responsible laboratory.

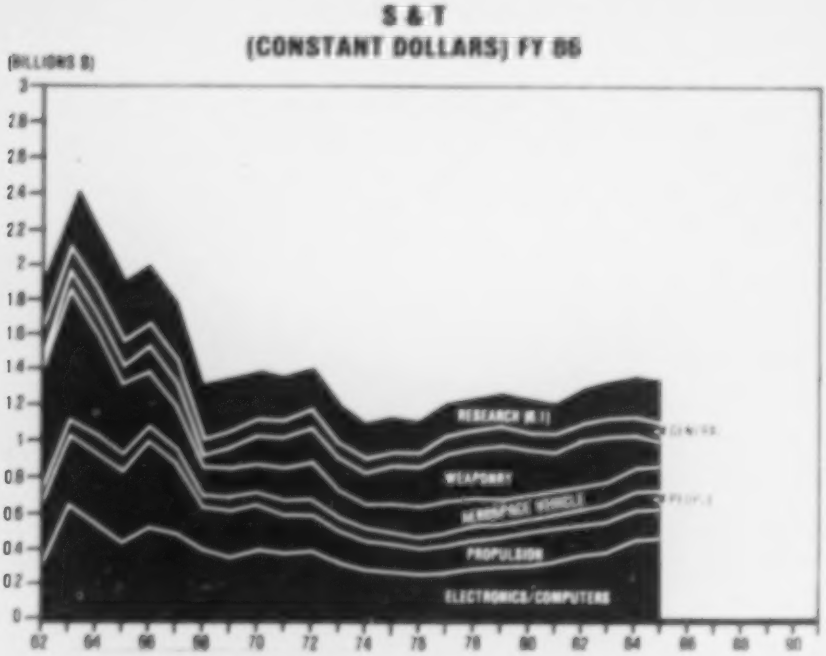
I don't believe it will obstruct any insight that the Congress gets.



S&T INVESTMENT

The next area is the emphasis, and the way we put emphasis on science and technology in the Air Force. Looking at it as a percentage of Air Force total obligation authority over the last two decades, we see that in the last 5 or 10 years or so, we have dropped off as a percentage of TOA.

This was a concern to the Air Force, because it looks like a decrease in emphasis in science and technology in the Air Force.



Looking at it on the basis of constant dollars, we find, although we did drop off from the sixties to the seventies, since that time, we have sustained about a constant level of investment, but we have not been taking advantage of some additional Air Force TOA in the S&T account.

### MANAGE S&T AS CORPORATE INVESTMENT

Objectives: Reverse trend of declining S&T emphasis; achieve quality S&T Program; avoid need for item-by-item review by senior executives.

Approach: Corporate review of S&T Program annually establish corporate guidance for PPBS.

That is the seed corn for the Air Force of the future, and so, in order to give a closer look at this in the Air Force, we have begun to take it on as an objective to reduce the trend in declining S&T emphasis, which has been represented by that plot I just showed you as a percentage of TOA. We want to make sure we achieve a quality science and technology, but avoid the item-by-item review we are often forced into, that pits a future science program against a current production program, and oftentimes that causes a gradual erosion of the science and technology account.

So our approach is to accomplish a corporate review within the Air Force of our entire science and technology program annually. On the basis of that, Air Force leadership will set corporate guidance to sustain the science and technology program as we go through budget exercises during the fiscal year.

Mr. Dickinson. Let me interrupt just a minute.

If, for instance, you send over a budget, last year, $13 billion for us, and more than that you sent over.

Dr. Cooper. $15.5.

Mr. Dickinson. This committee, or Appropriations, or whatever, takes a pretty good nick out of it, and you wind up with $13 million or $12 million, you asked for $3.8 billion in SDI, and $2.5 million, and the conference gave them $2.75 million, and I don't know what Appropriations finally did.

Are you comparing to what you have had in the past to—is this what you asked for, or what was authorized and appropriated?

AIR FORCE SCIENCE & TECHNOLOGY FY 87 PRESIDENT'S BUDGET

| | FY 86 | FY 87 | FY 88 |
|---|---|---|---|
| Budget activity category 2: | | | |
| Basic research (6.1) | 228 | 242 | 259 |
| Exploratory development (6.2) | 583 | 606 | 635 |
| Budget activity category 1: | | | |
| Advanced tedchnology development (6.3) | 665 | 784 | 728 |
| Total | 1476 | 1632 | 1622 |

General Rankine. This was what was authorized and appropriated, but I am speaking of the way we prepare our science and technology budget for the submission to the Congress each year, and the way we balance it with the amounts we spend in weapons system procurememt, other parts of O&M account, so forth.

As we try to balance the investment in science and technology with those other accounts, we are trying to take a more corporate view.

Mr. Dickinson. You are building on what you actually got, instead of what you requested, and when you come up with the next year's budget?

General Rankine. Yes, sir.

Dr. Cooper. A point on that, though. That is true. That is the way it looks, but many times we don't get our final budget out of the Congress. Case in point last year, until December for all practical purposes, our budget for the following year has already been put together, so there is a linkage there, but we really can't say that we are building on that.

That is one of the reasons that you see the increase in our R&D request this year, it is about 26 percent over what we got last year, but relative to what we requested last year, this year's budget is about 11 percent.

We did not actually get the final number, though, until mid-December last year.

Mr. Dickinson. Well, that is Weinberger arithmetic. They come over and say they are asking for 3 percent growth, 3 percent over what they requested, but 8 percent over what they got, and with inflation on top of that, it is 12 percent, so we play the numbers game.

Dr. **Cooper**. You have been around that maypole. The 3 percent was based on what the Department's perception was of the agreement that was reached midyear between the Congress and the administration.

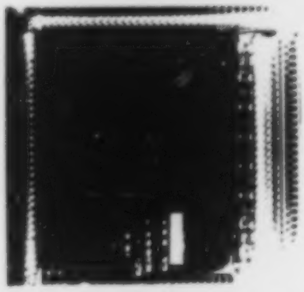
Mr. **Dickinson**. Who was that with?

Dr. **Cooper**. It was the budget agreement. That is not what came to pass.

Mr. **Dickinson**. It won't again.

General **Rankine**. Next, three programs of considerable interest. First, the Very High Speed Integrated Circuits Program, VHSIC, the objective was to develop two different generations of integrated circuits for military use.

## VERY HIGH SPEED INTEGRATED CIRCUITS
## (VHSIC)



- DEVELOPS TWO GENERATIONS OF MILITARIZED INTEGRATED CIRCUIT TECHNOLOGY
- WILL BE USED IN VIRTUALLY ALL MILITARY ELECTRONICS FOR IMPROVED RELIABILITY, MAINTAINABILITY AND PERFORMANCE
- INCREASES SIGNAL PROCESSING SPEED OVER 100 TIMES. REDUCES WEIGHT, POWER, AND COST BY A FACTOR OF 10
- FY 87: GOVERNMENT CERTIFICATION/QUALIFICATION OF PHASE 1 CHIPS AND DEMONSTRATION OF SYSTEM APPLICATIONS

Our objectives were to increase the processing speed by 100 times, reduce weight, power, cost by a factor of 10, and our fiscal year 1987 objective is to complete Government certification, qualification of the phase one chips, 1.25 micron minimum feature size integrated circuits.

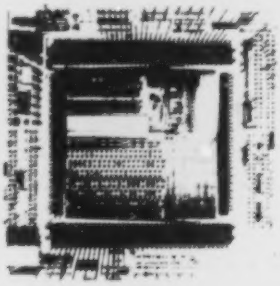
## VERY HIGH SPEED INTEGRATED CIRCUITS (VHSIC)

($ IN MILLIONS)

| | FY 85 | FY 86 | FY 87 | FY 88 | FY 89-FY 91 | TOTAL |
|---|---|---|---|---|---|---|
| RDT&E | 131.9 | 202.0 | 132.9 | 29.5 | 74.7 | 571.0 |

FY 87
RDT&E REQUEST
$ 132.9

- TECHNOLOGY INSERTION
- SUBMICRON TECHNOLOGY
- QUALIFICATION PROGRAM
- DESIGN TOOLS



SCHEDULE

| | |
|---|---|
| • 1ST GENERATION COMPLETE | FY 85 |
| • YIELD ENHANCEMENT COMPLETE | FY 86 |
| • AUTOMATED DESIGN TOOLS COMPLETE | FY 89 |
| • 2ND GENERATION COMPLETE | FY 91 |

Our budget request for fiscal year 1987 is approximately $133 million. We plan to break that up between technology insertion, $53 million; approximately $40 million for submicron technology, $16 million for the qualification program and $24 million for design tools.

Mr. BATTISTA. That program for submicron technology or the dollars you are asking for, that is not going to get you there in time, for what you want to do.

Advanced tactical fighter, you have got that, and a number of other new systems, and the Navy has some new systems that are dependent upon submicron technology, 32 architecture, main frame monochip, and I know it is a time of budget constraints, but this technology is so important to your future, I wouldn't understand why certain other programs have a higher priority than the submicron phase two.

General RANKINE. There are many technical areas where we could benefit by more dollars. We believe this year's investment in submicron technology will lead us to the ability to begin technology insertion of submicron beginning in fiscal year 1989, and that will meet our requirements.

Mr. BATTISTA. This money will do that?

General RANKINE. This money in 1987, $40 million, with the rest of the money out through 1988 and 1989, will allow us to begin technology insertion of submicron in 1989.

Mr. BATTISTA. This is what Sonny Manar asked for for 1987, $132 million, $28 million for phase two?

General RANKINE. $40 million.

Mr. BATTISTA. That is all he asked for.

General **Rankine**. Not originally, but this is the budget which OSD now supports.

Mr. **Battista**. What is happening to the MANTECH Program for phase one? We have got the chips now. Now we got to get the price down.

General **Rankine**. That is in these areas here; $16 million in qualification program, and $24 million in design tools, that is MANTECH.

Mr. **Battista**. This funding profile leads to the submicron insertion by 1990?

General **Rankine**. Beginning insertion process in 1989, yes, sir.

Mr. **Battista**. We asked you to look at, and I showed Dr. Cooper, the breadboard, the laser pantography effort at Livermore, within 18 months we are going to have a Cray Computer with a 5-inch silicon wafer, and that program has been underfunded by $3 million last year.

Any attempt to bring that up to the requisite level?

General **Rankine**. Yes, sir, we have been attempting to get in contact with Lawrence Livermore National Laboratory and arrange to meet with them. Up to this point, they have not been responsive to our half a dozen inquiries.

Mr. **Battista**. OK. Let's make some phone calls.

General **Rankine**. Appreciate your help. It looks very promising.

Mr. **Battista**. How much of your 6.1–6.2 budget are you putting into gallium arsenide, and in view of some of the problems for the SDI program, does it make sense to continue that gallium arsenide effort?

General **Rankine**. Yes, we believe it does make sense, because that gives us higher speed and a higher level of natural hardness, but we are behind in the number of gates on a chip.

The density is less, but the natural hardness and speed are greater.

Mr. **Battista**. Well, I am told that although you can sustain a much higher dose, the dose rate, it is just not there to support the gallium arsenide.

[The following information was received for the record.]

### Gallium Arsenide

The Air Force is spending approximately $20.5 million in FY 1986 and $22.9 million in FY 1987 in our technology base (6.1/6.2) program for gallium arsenide technology development.

The Air Force is developing gallium arsenide for a number of mission applications, ranging from tactical to space. Gallium arsenide has inherently higher processing speed than silicon and will be an excellent technology for applications such as radar signal processing. Our technology base gallium arsenide program is to mature the technology and make it available to system developers.

We have received different reports on the radiation hardness of gallium arsenide. As with silicon, we expect that design techniques will enhance the radiation hardness of gallium arsenide. For example, as silicon technology matured and different design techniques were used, the radiation hardness increased. We expect the same radiation hardness trend with gallium arsenide. Thus, we are convinced that continued technology base investment in gallium arsenide technology is warranted.

General **Rankine**. I will look into it.

General **Randolph**. Excuse me, if I may add on to that, we are doing a considerable amount of work in areas we cannot discuss in this open session, and I would like to bring that in and talk to you about that, if I may.

MANUFACTURING TECHNOLOGY OBJECTIVES

Transition manufacturing R&D into production.
Manufacturing cost reducion and quality enhancement.
Maintenance and repair productivity.
Reliability and maintainability.
Industrial base responsiveness.

General **RANKINE**. Manufacturing technology, now, this is not in the science and technology account, but it is technology, and just as advanced development is necessary to demonstrate that science works in an airplane or spacecraft, we find that manufacturing technologies are oftentimes necessary in order to be able to manufacture new science, produce it in an affordable way, and so a very important piece of transitioning technology into application is making sure that science can also be manufactured in an economical way, and in many cases, that is the foundation for the manufacturing technology program.

MANTECH PROJECT CRITERIA

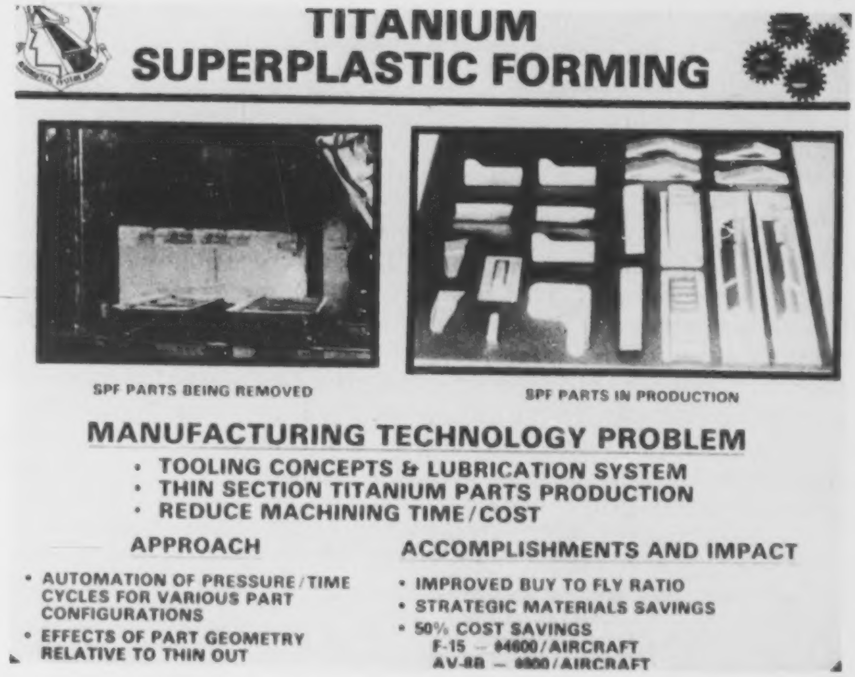
Must address generic technology program.
Must provide tangible DOD benefits.
Must be beyond normal risk of industry.
Must be competed to industries/universities.

Our manufacturing technology program must meet these four criteria: a generic technology problem, not just at one company; they must provide tangible DOD results—and in every contract that we let since fiscal year 1985, we require that tangible results for manufacturing technology must be identified in the contract, if that is to be pursued any further; we must go beyond the normal risk industry would be willing to accept; and it must be competed to industry and universities.

TANGIBLE BENEFITS

Assessed 75 recent projects.
Fifty percent of projects implemented.
Dissemination to American industry.
Cost savings—$593 million, 11:1 return.

We assessed a couple of years ago 75 recent projects at several different companies, and found that at that time, selecting 75 at random, 50 percent had already been implemented, and they were in the process of being disseminated throughout American industry, and the return on that investment was a cost savings of $593 million against investment, on 11 to 1 return.



## TITANIUM SUPERPLASTIC FORMING

SPF PARTS BEING REMOVED

SPF PARTS IN PRODUCTION

### MANUFACTURING TECHNOLOGY PROBLEM

- TOOLING CONCEPTS & LUBRICATION SYSTEM
- THIN SECTION TITANIUM PARTS PRODUCTION
- REDUCE MACHINING TIME/COST

### APPROACH

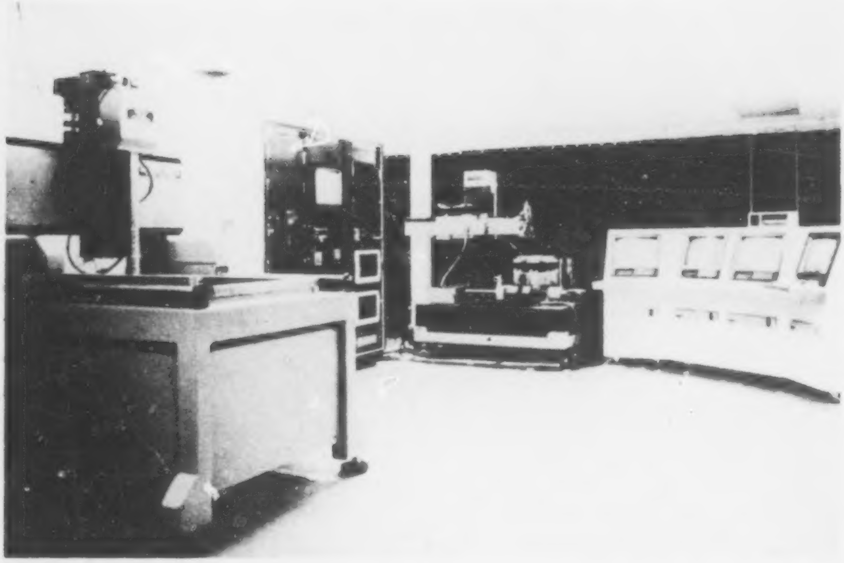
- AUTOMATION OF PRESSURE/TIME CYCLES FOR VARIOUS PART CONFIGURATIONS
- EFFECTS OF PART GEOMETRY RELATIVE TO THIN OUT

### ACCOMPLISHMENTS AND IMPACT

- IMPROVED BUY TO FLY RATIO
- STRATEGIC MATERIALS SAVINGS
- 50% COST SAVINGS
  F-15 — $4600/AIRCRAFT
  AV-8B — [illegible]/AIRCRAFT

To illustrate the kind of high leverage that mantech provides, I have a few examples to put it into perspective. Titanium superplastic forming, this is a manufacturing process that allows us to build titanium parts for airplanes with less scrap laying on the shop floor.

That means a reduction in the use of strategic materials, and a reduction in the cost of manufacturing and the end result is that for each F-15 we produce today, we save $4,600 per aircraft, and that is one example.

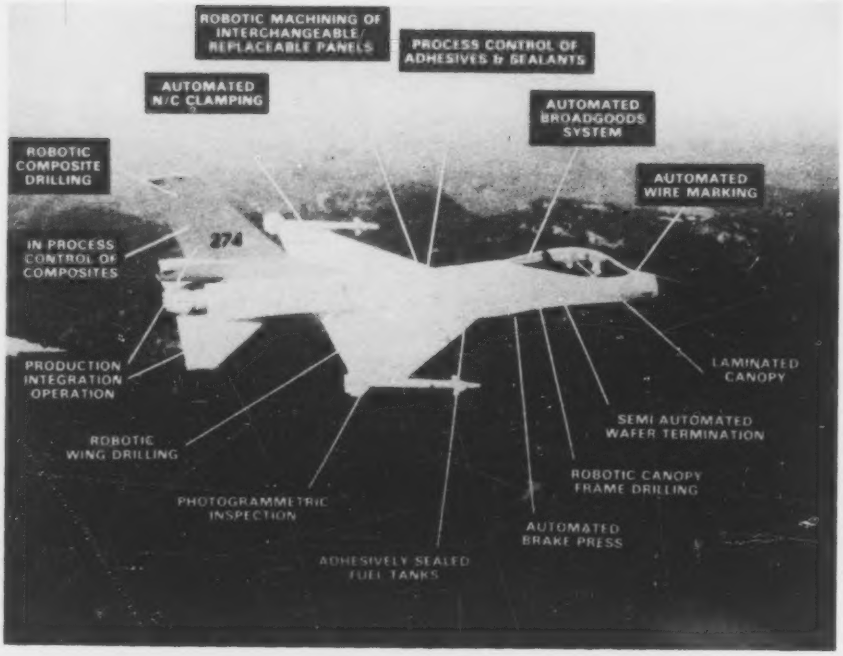


Application of manufacturing technology to the reduction of the operation and maintenance account is shown here.

This is a program we call retirement for cause. When we take engines into the depot for repair, we take the disks out of those engines and discard them if the life has been quite long.

In fact, we are discarding good parts sometimes, but we have to be conservative with engine safety. This allows us to look for microcracks in those disks, and only retire those which have the microflaws, and return the others to service, and in so doing, we can reduce the cost of depot maintenance.

In fact, we estimate a cost reduction of $450 million will be realized over the life of the F-100 engine through the reduced spare parts acquisition.


ROBOTIC MACHINING OF INTERCHANGEABLE/ REPLACEABLE PANELS
PROCESS CONTROL OF ADHESIVES & SEALANTS
AUTOMATED N/C CLAMPING
AUTOMATED BROADGOODS SYSTEM
ROBOTIC COMPOSITE DRILLING
AUTOMATED WIRE MARKING
274
IN PROCESS CONTROL OF COMPOSITES
LAMINATED CANOPY
PRODUCTION INTEGRATION OPERATION
SEMI AUTOMATED WAFER TERMINATION
ROBOTIC WING DRILLING
ROBOTIC CANOPY FRAME DRILLING
PHOTOGRAMMETRIC INSPECTION
AUTOMATED BRAKE PRESS
ADHESIVELY SEALED FUEL TANKS

If we take any aircraft today that is in production—we have used the F-16 as an example—in any aircraft you will find a whole host of automated machine processing, robotics, building laminated canopies (that is, complex structures of transparent materials), all of those technologies arose out of our manufacturing technology program, and it is a very worthwhile investment.

FY 1987 MANTECH BUDGET

[In million of dollars]

| | FY 1985 | FY 1986 | FY 1987 |
|---|---|---|---|
| FY 1986 PB request | 56.0 | 104.5 | 117.9 |
| FY 1987 PB request | 53.9 | 62.9 | 83.6 |

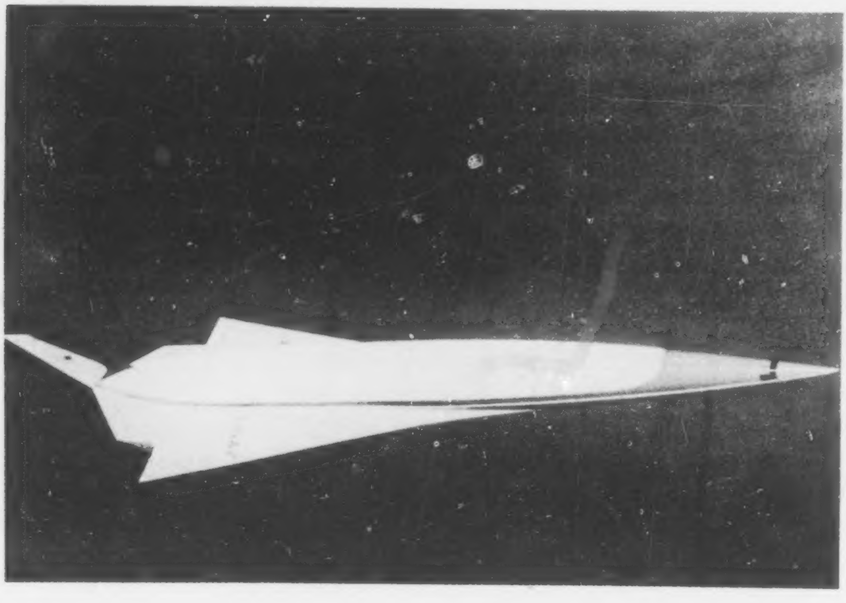
So, for this year, we are requesting $83.6 million in the budget, up from $62.9 last year.

We were seeking a very large amount of growth last year in the President's budget, but the outcome was a number substantially less than that, and we have gone in with a more conservative amount of growth this year, but we seek the subcommittee's support in that larger amount, because we believe that is high leverage investment.

Next, the National Aerospace Plane, to put it in perspective, it is interesting to go back into history to 1942; this is the XP-59A, the very first turbojet.

Mr. HERTEL. You saved us a lot of questions.

Dr. COOPER. (Referring to a model of the National Aero-Space Plane) This is not Air Force 1, but our concept, $90 million in R&D, we have scaled it back, and we are looking at the 747 and the DC-10 right now. [Laughter.]



General RANKINE. I believe we are on the eve of a revolution in aviation and in aerospace which may be as great as what we experienced with the introduction of the turbojet in 1942.

Today, we are all flying around with turbine engines, and indeed, perhaps beyond the year 2000 we will be flying around in ramjet powered aircraft.

**BOTH AN AIRPLANE**
**AND A SPACE PLANE . . . .**

**WITH POTENTIAL PAYLOAD-TO-ORBIT COSTS 1/10 OR LESS OF TODAY'S COSTS**

The concept of an aerospace plane makes it both an airplane and a space launch vehicle, and it looks very promising now that such a vehicle could provide a potential payload to orbit cost of maybe one-tenth of what we are experiencing today, or less.

We often get asked, what is it that is new in science and technology that makes us able to do something like this today, and not before now, if it is that good. Three technologies have come together at one point in history that make this now possible.

WHAT'S NEW

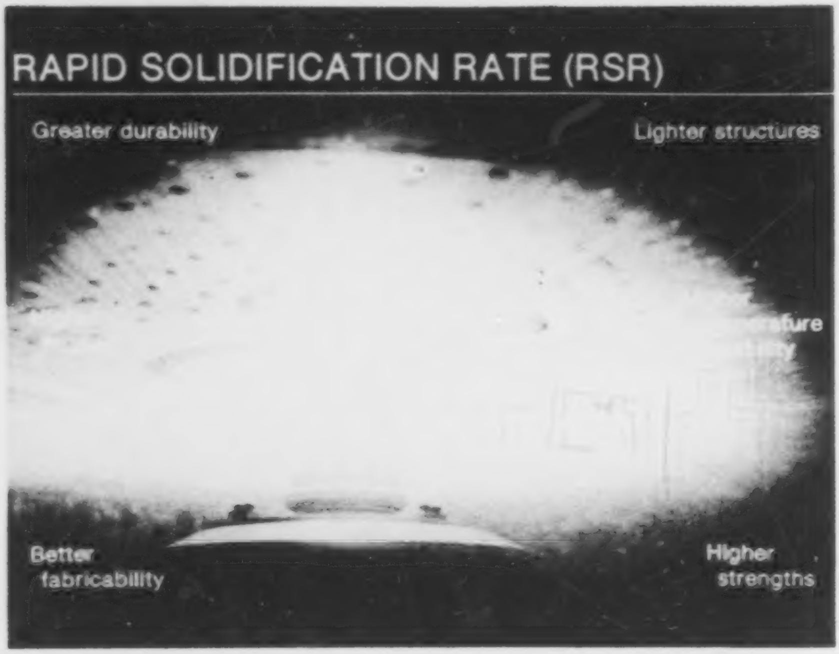
Advanced airbreathing propulsion.
High temperature/high strength/lightweight materials.
Supercomputers to design integrated engine-airframe.

The first is air breathing propulsion—ramjets, scramjets—high temperature, high strength materials and super computers, and we have been working for many years on these, for example, here is an Air Force program that worked very successfully.

AIR FORCE DUAL MODE SCRAMJET

U.S. AIR FORCE

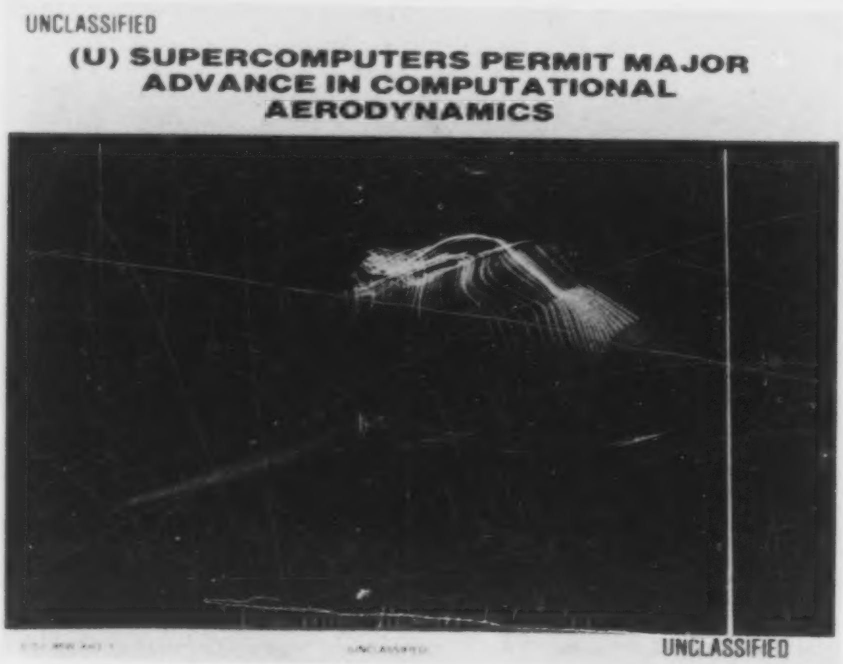
This engine operated at scramjet velocity, had internal combustion occurring at supersonic velocities.



RAPID SOLIDIFICATION RATE (RSR)

Greater durability
Lighter structures
Better fabricability
Higher strengths

Another example is the Rapid Solidification Rate Program, which allows us to build alloys which are lighter, higher temperature capability, stronger than current alloys, and we could not obtain those if we were not able to get the very rapid cooling that the manufacturing process makes possible.



UNCLASSIFIED

(U) SUPERCOMPUTERS PERMIT MAJOR ADVANCE IN COMPUTATIONAL AERODYNAMICS

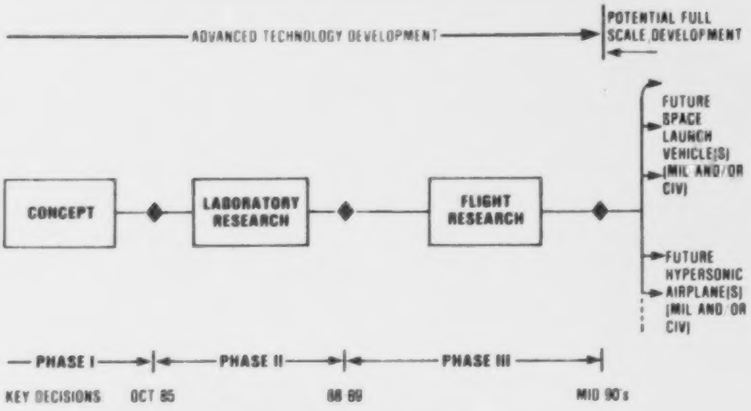
UNCLASSIFIED

And finally, the introduction of the super computer.

I have here the space shuttle with a computer-generated diagnosis of the flow over the shuttle. That kind of technology which gives us the exact solutions to the equations of the flow over the vehicle and in fact, even the exact motion of the particles within the engine, allows us to iteratively design the vehicle to a very closely coupled propulsion system. We design it on the computer, where it took us years previously by cut and try.

We can converge to a solution much quicker and put the wind tunnel model in the wind tunnel. We are more likely to be close to the actual solution.

## NATIONAL AEROSPACEPLANE PROGRAM


ADVANCED TECHNOLOGY DEVELOPMENT
POTENTIAL FULL SCALE DEVELOPMENT
CONCEPT
LABORATORY RESEARCH
FLIGHT RESEARCH
FUTURE SPACE LAUNCH VEHICLE(S) (MIL AND/OR CIV)
FUTURE HYPERSONIC AIRPLANE(S) (MIL AND/OR CIV)
PHASE I
PHASE II
PHASE III
KEY DECISIONS
OCT 85
88 89
MID 90's

OBJECTIVE OF ADVANCED TECHNOLOGY DEVELOPMENT PROGRAM

PROVEN TECHNOLOGY BY MID-90s TO SUPPORT FSD DECISION(S) ON AEROSPACEPLANE APPLICATIONS

It is the combination of those technologies that make it possible. The program that we are talking about is based upon concept development work, concept exploratory work done by DARPA under the Copper Canyon Program, that we call phase 1.

Based upon that research which looked at all of the science going on in Government, industry across the entire United States from 1982 to 1985, it was that overall concept work that led to the conclusion that perhaps we could build someday a plane such as this.

The phase we are entering now, phase 2, is predominately laboratory research. We are going to build an engine and test it in an engine test facility, but we can only test that engine up to mach 8, full-scale, continuous run.

To get to the higher mach numbers, 10, 15, 20, the only way to do that is in the air, fly a research vehicle, so we have a flight research stage to go to, and that is a flying laboratory.

It is not a vehicle that will be able to execute some military or civil mission, but a research vehicle, an X vehicle, if you will. When we complete that particular flight test program, we will be able to say, we have a hand on the technology to go into full-scale development and production of a whole new generation of vehicles, again much like the turbojet's first test resulted in new military and civil aircraft.

NATIONAL AEROSPACE PLANE FY 1987 PRESIDENT'S BUDGET

[In millions of dollars]

| | FY 87 | FY 88 |
|---|---|---|
| DOD | 150 | 285 |
| (Air Force) | (34) | (86) |
| NASA | 62 | 74 |
| Total | 212 | 359 |

New civil and military space launch vehicles, as well, is what we are talking about. The request for the National Aerospace Plane is a DOD request for $150 million for fiscal year 1987.

NASA is requesting another $62 million, for a total of $212 million. The Air Force portion of that is $34 million for fiscal year 1987.

Mr. Chairman, that concludes my remarks. Thank you very much.

Mr. DARDEN. Mr. Chairman, I am glad we were able to have manufacturing technology explained this year. Last year, nobody could. Your detailed explanation was very interesting.

Mr. BATTISTA. One of the objectives here is to produce a vehicle that has about 10 to 20 percent of the gross weight of the shuttle, with the same payload carrying capacity, right?

General RANKINE. Yes.

Mr. BATTISTA. When you gave me the briefing all of this stuff was classified. Is this now all declassified? Everything beyond the Orient Express was going to be——

General RANKINE. What I gave you just now has been cleared for public release, and it has been given in speeches and so forth. What I gave you now has been carefully stated to not disclose any classified information.

I can pursue that with you.

Mr. BATTISTA. No problem. We would appreciate it when you are going to change the ground rules.

General RANKINE. I don't believe we did, sir.

Mr. BATTISTA. You said in a meeting anything beyond the Orient Express, we are going to keep classified, and now I am hearing mach 10, mach 20. Let us know in advance.

General RANKINE. There are certain critical technologies which need to be protected.

Mr. BATTISTA. Give us an update on those.

Dr. COOPER. That is a fair question. This has moved very quickly. Some of our technology effort has come out of the classified world into the open recently, and the program has gained momentum very quickly.

If we could, in the interest of time, we will now move on, we have a special presentation on a noncontroversial program called AMRAAM, and I thought it was important enough to ask General Tom Ferguson to give you a status report.

[The following information was received for the record:]

## NATIONAL AEROSPACE PLANE

Immediately after the announcement of the existence of the Copper Canyon program, we were still very sensitive about discussing publicly any information concerning what was a very closely held project. A security classification guide has been in preparation and is now being coordinated by all participants. DoD and NASA agreed from the beginning, and still agree, there are certain critical technologies which must be protected. All releases of information have been carefully screened by both DoD and NASA. In cases where new or potentially sensitive information was concerned, Dr. Hicks has reviewed and approved, or disapproved, release. In no case, however, has there been any change in procedure concerning the sensitive technologies.

The technologies in question involve (a) advanced propulsion system concepts and (b) high temperature, high strength, lightweight materials. In the propulsion area, we have indicated that, in part of the velocity profile, ramjets and supersonic combustion ramjets would be employed.

[Deleted] In the materials area, we have said we are considering superalloys, rapid solidification rate (RSR) techniques, and composites. [Deleted]. You will also note that military missions are only discussed in general terms, and that performance information is given only in the broad ranges.

The classification level of the material involved is at present only SECRET. The important technology information is, however, being handled on a Controlled-Need-to-Know (CNTK) basis, with strict sign-up procedures being followed. As the program matures, and work is done on specific military applications and survivability/vulnerability analysis, it is conceivable some information could be more highly classified. A security classification guide can be made available if desired.

## STATEMENT OF BRIG. GEN. THOMAS R. FERGUSON, JR., USAF, DEPUTY FOR AMRAAM ARMAMENT DIVISION, AIR FORCE SYSTEMS COMMAND

General FERGUSON. It is a pleasure to be here, and nice to come out of down home areas and come back north again.

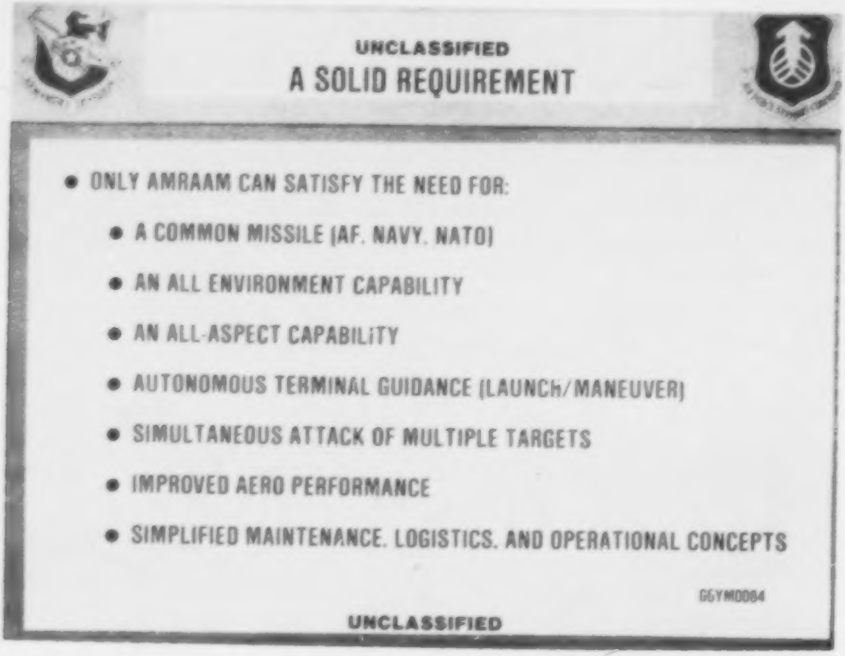
AMRAAM
AIM-120A

The AMRAAM program is a joint effort with the Navy. I have Navy personnel co-located with me in my program office. The buy is a split of the 24,000 missiles, and 7,000 will go to the Navy.

We are an international program, and operate under a family of missiles MOU, and two of the participants are represented here by the national flags, United Kingdom and Germany.

The United Kingdom plans to go operational with AMRAAM first on their sea Harrier airplane, and they found the experience in the Falkland Islands was such that they needed to obtain funding legislation for AMRAAM and beyond visual range capability.

Germany intends to upgrade their F-4 program and go operational on their F-4F. Not represented on this chart, but our prime contractor is Hughes Aircraft Co., leader and a follower, Raytheon Co.



UNCLASSIFIED

A SOLID REQUIREMENT

- ONLY AMRAAM CAN SATISFY THE NEED FOR:
  - A COMMON MISSILE (AF, NAVY, NATO)
  - AN ALL ENVIRONMENT CAPABILITY
  - AN ALL-ASPECT CAPABILITY
  - AUTONOMOUS TERMINAL GUIDANCE (LAUNCH/MANEUVER)
  - SIMULTANEOUS ATTACK OF MULTIPLE TARGETS
  - IMPROVED AERO PERFORMANCE
  - SIMPLIFIED MAINTENANCE, LOGISTICS, AND OPERATIONAL CONCEPTS

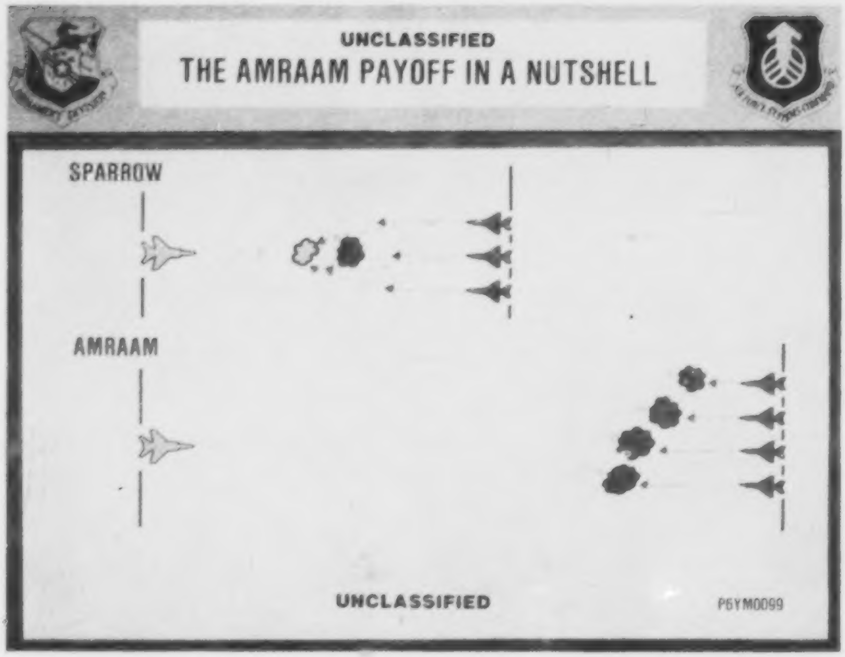
GGYM0084

UNCLASSIFIED

A few points, the requirement for AMRAAM is solid, broadly based and derived from the points shown here on the chart. Very briefly, common missile, I have talked about some of the features on my introductory chart, but will put a beyond-visual-range capability on our F-16's as well. As an all-environment missile, it can operate in all weather. It is a radar missile, and can also operate in sophisticated electronic warfare environments.

Target aircraft—autonomous terminal guidance, and simultaneous attack of multiple targets, 30 percent improved and better aerodynamics performance, as compared to the AIM-7's.

We will provide simplified maintenance and logistics and operational concepts. In a nutshell, I have tried to capture what the critical and most important features that AMRAAM will bring to the fighter pilot.



UNCLASSIFIED

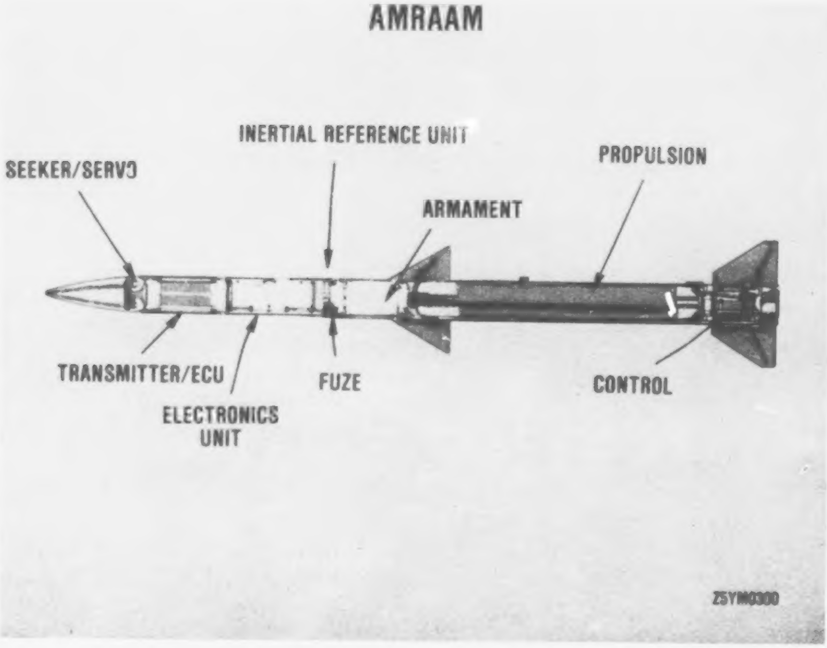
THE AMRAAM PAYOFF IN A NUTSHELL

UNCLASSIFIED

Sparrow, when launched from our F-15, as shown in this example, must only focus and can only attack one target at a time. His radar must be continuously tracking the target airplane during the flyout of the Sparrow missile.

What this means is that the forces tend to collapse. Our airplanes become vulnerable to other medium-range missiles that may be launched. This is to be avoided when you are significantly outnumbered, and that is the case in central Europe.

AMRAAM corrects that situation, and that was the initiation and the requirement for this missile. We can launch from further distances, handle multiple targets at one time and launch, maneuver, and leave.



In the missile itself, the launch maneuver capability is provided by an active radar; you have an aircraft radar packaged into the missile. The active feature, of course, is the difference that distinguishes AMRAAM from the Sparrow.

The inertial reference unit extends our autonomous range beyond that which arrived from the radar itself. Rocket motor, very low signature, the missile tail control giving AMRAAM more agility.

The following film clip has been prepared to give you a status report.

The status report will start off with warhead tests conducted at the Armament Division. This is the fuselage, and it has not been damaged. The missile is propelled into the arena, warhead detonated; another view of the detonation.

Once the smoke clears, you can see the type damage. The setup here was about the distance that you would normally expect in an average distance, a very, very effective warhead which is now qualified.

The rocket motor is going through our qualification process; Hercules is the vendor; 48 missile firings have successfully qualified.

This is a chassis, the core of the AMRAAM electronics. We built 300, and in 87 of those, 40 percent of the total requirement in the full-scale development effort have been tested on stations, and 32 have been approved.

We are building this missile in a pilot plant environment.

This is an electronics unit, and we have built 43 of these. This is just one of the eight chassis. The electronics unit shown on the previous picture is coming into view just now. It is the front end of the missile, the seeker.

We test the missile in an open configuration like this, skin it, and accept it in a final assembly.

Twenty-three missiles have been delivered now in the program. Out of our total requirement of 122, about 20 percent of the FSD requirement has now been delivered for test.

A facility is in use at the Raytheon facility in Massachusetts as well.

F-15 with AMRAAM representative equipment is contained in this part. We can fly the AMRAAM equipment, software, and establish missile performance in a number of attack-type situations.

We have flown 92 sorties, the Navy's F-18, with the second generation of our captive equipment that we call ACF. And we have completed 850 data passes in various attack representations, and the hardware has proven to be an excellent development tool.

This part shows environmental testing with the F-16 and AMRAAM. We are complete on all the testing on the F-15, F-16, and 75 percent on the F-18. This tells us that the missile is properly specified for the flight environment.

Harrier suitability work is now complete. Here AMRAAM is carried on the wing of the Navy's F-18, demonstrating to us that the missile is properly specified.

Maintainability: Here you see an AMRAAM being loaded out of a shipping and storage container, and four missiles are in the pod pack, and a one-step loading adaptor, a development of Armament Division, and we were able to load out four missiles onto eject stations as well as launcher rails in 1 minute less time than we can currently do.

Load-out demonstrations on the F-16 and the F-18, and in the case of the F-18, the missiles were loaded 4 in 11 minutes, 4 minutes less than the requirement stated by the Navy.

The men who have worked with these pieces of hardware are pleased. In the Guided Launch Program, this part shows the first off of the F-16, going smoothly off the rail. This part shows the missile at fairly short range, about 2.5 miles; the missile is in flight and passes over the right wing of the drone. That would have been a lethal shot had a warhead been on board.

Our second guided missile came off of the F-15, and I am going to show you photography through the F-15 to illustrate we are doing development work.

Here you see the missile come out of the left-hand side. The other launches were done in slow motion, and this is a picture of that missile departing the F-15 rail in slow motion.

Our second shot, this was done in a lookdown, shootdown environment in heavy clutter, was a very successful shot. In the third mission off the F-16, once again, you will notice how clean-burning the rocket motor is; one of our development objectives, is to reduce the signature of the missile while in flight.

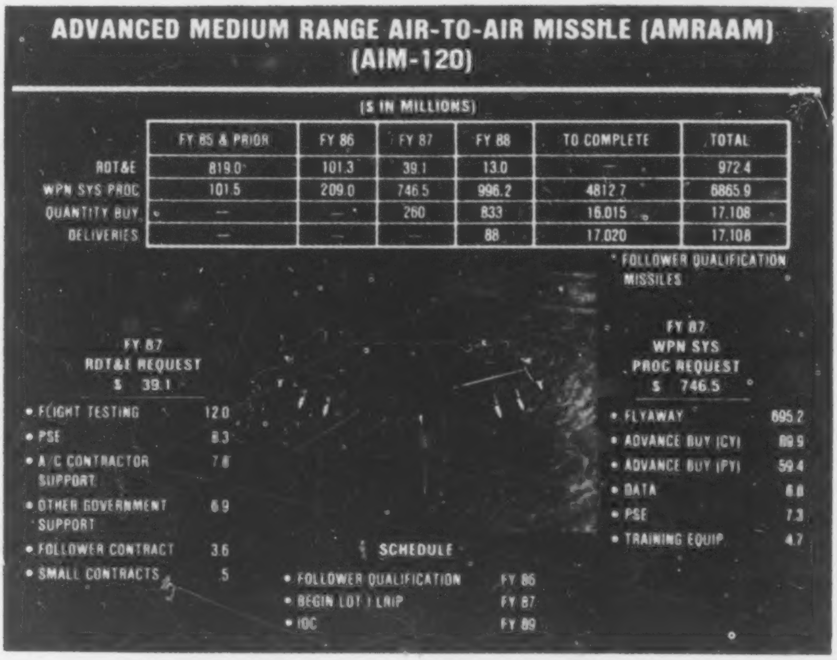
In this case, we operated with the F-16 radar data linking target position updates to the missile, and this was a direct hit, no warhead, a kinetic energy impact, once again successfully meeting all our objectives for that launch.

I have two missiles at Holloman Air Force Base with the third on its way out this weekend.

We have three missiles in place for launches next month.

Mr. McCurdy. Does it have to actually strike?

General Ferguson. No, it has a radar fuse. The fuse will detect target position, and a fuse like that is necessary, because we will use the missiles against very small as well as very large targets.



ADVANCED MEDIUM RANGE AIR-TO-AIR MISSILE (AMRAAM) (AIM-120)

($ IN MILLIONS)

| | FY 85 & PRIOR | FY 86 | FY 87 | FY 88 | TO COMPLETE | TOTAL |
|---|---|---|---|---|---|---|
| RDT&E | 819.0 | 101.3 | 39.1 | 13.0 | — | 972.4 |
| WPN SYS PROC | 101.5 | 209.0 | 746.5 | 996.2 | 4812.7 | 6865.9 |
| QUANTITY BUY | — | — | 260 | 833 | 16.015 | 17.108 |
| DELIVERIES | — | — | — | 88 | 17.020 | 17.108 |

* FOLLOWER QUALIFICATION MISSILES

FY 87 RDT&E REQUEST $ 39.1

| | |
|---|---|
| • FLIGHT TESTING | 12.0 |
| • PSE | 8.3 |
| • A/C CONTRACTOR SUPPORT | 7.8 |
| • OTHER GOVERNMENT SUPPORT | 6.9 |
| • FOLLOWER CONTRACT | 3.6 |
| • SMALL CONTRACTS | .5 |

FY 87 WPN SYS PROC REQUEST $ 746.5

| | |
|---|---|
| • FLYAWAY | 695.2 |
| • ADVANCE BUY (CY) | 88.9 |
| • ADVANCE BUY (PY) | 59.4 |
| • DATA | 6.8 |
| • PSE | 7.3 |
| • TRAINING EQUIP | 4.7 |

SCHEDULE

| | |
|---|---|
| • FOLLOWER QUALIFICATION | FY 86 |
| • BEGIN LOT I LRIP | FY 87 |
| • IOC | FY 89 |

The Air Force request for fiscal year 1987 $39 million. The Navy request is an additional $19 million for development.

This is, of course, the first year that we get into production, 260 missiles. Of that, 120 will be produced by Raytheon and 140 by the Hughes Aircraft Co. Ninety percent of the funds in the development phase of the program have now been authorized and appropriated.

Balance of the funds, 10 percent that are remaining, are fairly represented by what we intend to do in fiscal year 1987.

With the flight testing, support of our launch airplanes, other Government support really is doing analysis and support of flight test or missile evaluation kinds of activities.

The large majority of our funds are committed to the evaluation of the missile, not development.

Dr. Cooper. That is a key point. Approximately 95 percent of the development of the AMRAAM is funded now, with funds in hand. If you look up there, 1987 and 1988 are the last 2 years, and relative to the $900-some million that has already been authorized and appropriated, there is a small amount left in R&D.

We are ready to enter production here shortly.

General **Ferguson**. One last comment, we have completed now all of the necessary actions to put the Raytheon Co. under contract to qualify as a second manufacturer on the program. The first missile to evaluate from that company then appears at the end of fiscal year 1987.

That concludes my presentation, gentlemen.

Mr. **Dickinson**. General, you gave us gross figures, but I didn't see the unit cost up there. What are you using for a unit cost, flyway cost?

AF/NAVY COMBINED JAN 86 RATES

[Unit costs]

| | FY78 dollars | FY84 dollars | TY dollars |
|---|---|---|---|
| Recurring flyaway | 0.134 | 0.232 | 0.321 |
| Flyaway | .151 | .259 | .355 |
| Procurement | .167 | .288 | .393 |
| Program | .196 | .334 | .439 |

General **Ferguson**. $259,000, stated in fiscal year 1984 dollar terms. $259,000, and that is a combined Air Force-Navy buy number. That is stated in fiscal year 1984 dollars.

Mr. **Dickinson**. OK.

Dr. **Cooper**. That is procurement unit cost?

General **Randolph**. No, flyway.

Mr. **Dickinson**. The Secretary of Defense is in the process now, and in the process of deliberation of certifying weapons, and he is going to put a cap on it at some figure?

Dr. **Cooper**. $5.2 billion in 1984 dollars, mandated by law. He doesn't have a choice on the cap. That was legislated last year.

Mr. **Dickinson**. This is lower even than the cap mandates it, $259,000 per unit flyway.

General **Ferguson**. That is consistent with the $5.2 billion cap.

Dr. **Cooper**. That was for 17,000 missiles. That was the Air Force buy.

The corresponding cap for the total 24,000 is $7 billion. That is the combined Air Force-Navy buy, and as a subset of that is the 17,000 Air Force that Mr. Weinberger is in the process of certifying.

To my knowledge, he has not yet signed the certification. However, it is in his office for signature and his staff has coordinated. It is now his decision as to whether or not he does.

Mr. **Dickinson**. We have used so many figures, and I am not sure that we are always comparing apples to apples. We had our own staff guy from the committee, and then contract employees that did a study 2 years ago, and we tried to come up with cost, and this is before Raytheon got into it, but the figure that our staff, the best figure they can come up with was somewhere around $750,000 a unit.

Dr. **Cooper**. I believe that was then-year program unit costs.

Mr. **Dickinson**. Total program unit costs, and the Air Force used the figure, at best, you had promised $450,000?

Dr. **Cooper**. In that vicinity.

AF ONLY JAN 86 RATES

[Unit costs]

| | FY78 dollars | FY84 dollars | TY dollars |
|---|---|---|---|
| Recurring flyaway | 0.146 | 0.251 | 0.343 |
| Flyaway | .168 | .289 | .389 |
| Procurement | .177 | .304 | .407 |
| Program | .212 | .359 | .461 |

General RANDOLPH. $461,000 (AF only).

Mr. DICKINSON. Program unit cost?

General RANDOLPH. Then-year (AF only).

Mr. DICKINSON. $259,000 per cost, we are talking constant 1984 dollars?

General RANDOLPH. Yes, sir (AF/Navy combined).

Mr. DICKINSON. For a buy of 24,000, and flyway costs, General?

General RANDOLPH. The cost I gave you, $461,000 is program unit cost (AF only), and in then-year dollars, assuming a buy of 24,000.

Mr. DICKINSON. Program cost, that is what?

General RANDOLPH. Everything, all research and development. It is $461,000. (AF only).

Mr. DICKINSON. $461,000. Total program unit cost in then-year dollars.

General RANDOLPH. Yes, sir.

Mr. DICKINSON. $259,000 per bird is constant dollars in flyway costs?

General RANDOLPH. Right. (AF/Navy combined).

Mr. DICKINSON. No R&D, nothing else, just to buy one more bird?

General RANDOLPH. A comparable number in then-year dollars to match the $259,000 is $355,000. That is a comparable number, escalated, though, for then-year dollars. (AF/Navy combined).

Mr. DICKINSON. What is it that the Secretary is going to certify now? This last figure in then-year dollars?

Dr. COOPER. That the $5.2 billion, the law requires that he certify that we can build 17,000 missiles for $5.2 billion in 1984 dollars. That is the way the certification, at least the last we saw it, was couched.

Mr. DICKINSON. Single source?

Dr. COOPER. No, sir, a couple of points for you. First of all, I think the program this year in every respect is stronger than it was at a comparable time last year, and I honestly believe that. The program is joint in nature, Air Force-Navy, international in nature, and we have both the British and the Germans that are signed on.

There is vigorous competition, over 95 percent of the missiles will be competed head to head between Hughes and the Raytheon Cos. We got a vigorous producibility contract, and we are in hopes that Mr. Weinberger will certify the program because of that.

The test core program has gone well, and we have had three successful shots, actually four, and the one shot ended up perfect. We didn't intend for it to hit, so I think in all respects, the program is stronger, and we think the costs have stabilized. It is more expensive than Sparrow.

Sparrow does not go on the F-16. We can put two on the F-16, but it isn't equipped to take it today. Sparrow is not launch and leave; it's a heavier missile, not as maneuverable.

You asked me to give you a list of priorities. We have been at this program for 10 years, and I know you were interested in some of the chronology. This program got started when I joined the committee staff in 1976. We had a competition at that point, five contractors involved, and we down selected to two, and that was followed by another competition, and Hughes won that competition, and entered full-scale development, and we brought Raytheon back on as a second source.

Ten years ago, we started it. Ten years from that point, we are now ready for production. We believe we will be able to release long lead funds in the July timeframe of this year. We spent close to $1 billion on research and development to date.

That doesn't make any sense to talk about program unit costs any longer, because the R&D bill has been paid, for all practical purposes.

We are really talking procurement, production unit cost, so when you look at the number of F-15's and F-16's that we will have on the ramp when the AMRAAM comes into the inventory, and place a value on that, we are talking close to $100 billion worth of F-16's and F-15's, tremendous investment in new airplanes.

It would be foolhardy indeed not to spend the 7-some percent investment that we are talking about to buy an AMRAAM missile, because that is our leverage for the future, the thing that we think will give our tactical fighter force the competitive edge that we need through the nineties, and through the year 2000. To build an advanced tactical fighter without an AMRAAM type missile, would be foolhardy in the most.

Mr. McCurdy. Are those fixed priced contracts?

Dr. Cooper. They are fixed price contracts, not-to-exceeds, but they will be fixed price.

General Ferguson. The initial Hughes contract was fixed price. It is now essentially fixed price, because the work is at ceiling, at the $556 million level.

Mr. Hertel. The ceiling?

Dr. Cooper. We have gone through the ceiling. The limit of Government liability on the FPIF contract by law on Hughes is $556 million. We estimate Hughes will go into the hole about $200 million out of their own pocket to complete the full-scale development contract.

Once you hit ceiling, the Government liability has been limited at that point. Unless the contractor walks away from the program, which he is not going to do, he has to continue to perform, and our best estimate is they will spend $200 million out of their own pocket to complete it.

And not only that, I don't know what the numbers are, but I have heard numbers bandied around between $50 and $100 million that both Hughes and Raytheon spent in the original competition out of their own pocket, so there has been a tremendous investment by the contractors themselves, in trying to win this business.

We anticipate that that competition will continue in the future, and we think not only is there a U.S. market for this missile, but there will be an international market for it as well with our allies.

Mr. **Dickinson**. If you would, give me a comparison of the characteristics of the Sparrow, the Sidewinder and the AMRAAM in cost, and capabilities?

Dr. **Cooper**. Let me ask General Ferguson, put up that cost comparison chart, we can do it on Sparrow and AMRAAM. The Sidewinder is the IR missile; less expensive than both of these; tremendously capable weapon; a clear-weather weapon; and doesn't allow you to fight in weather, at night, in a short range.

Mr. **Dickinson**. Maybe you can just give us this later, if you don't have it now, the three I have asked for and include the Phoenix, too.

### COMPARISON OF COST AND CAPABILITIES

The following cost data is based on the FY 87 President's Budget:

#### RECURRING UNIT FLYAWAY COST

[In millions of dollars.]

| | Fiscal year— | | Then year dollars | Quantity |
|---|---|---|---|---|
| | 1978 dollars | 1984 dollars | | |
| AIM-9M: | | | | |
| AF only | 0.029 | 0.050 | 0.053 | 11,627 |
| AF/USN | .030 | .052 | .057 | 19,317 |
| AIM-7M: | | | | |
| AF only | .096 | .165 | .167 | 6,304 |
| AF/USN | .097 | .167 | .181 | 17,642 |
| AIM-54C: | | | | |
| USN only | .310 | .559 | .763 | 7,204 |
| AIM-120: | | | | |
| AF only | .146 | .251 | .343 | 17,108 |
| AF/USN | .134 | .232 | .321 | 24,244 |

A chart providing performance comparisons for these same missiles follows:

### AIR-TO-AIR MISSILE RANGE COMPARISON

*Case 1:* Co-altitude/Co-speed; Launch: 20,000 ft. Mach 0.9; Target: 20,000 ft. Mach 0.9.

*Case 2:* Look-Down/Shoot-Down; Launch: 20,000 ft. Mach 0.9; Target: 1,000 ft. Mach 0.9.

| Missile | Aircraft | Guidance type | Maximum range (NM) | | Survival/Break-Away Range (NM)[1] | F-Pole (NM)[1] |
|---|---|---|---|---|---|---|
| | | | Head-On[1] | Tail[1] | | |
| Case 1: | | | | | | |
| AIM-9M | F-15/16 | Infrared | | | | |
| AIM-7M[2] | F-15/16/F/A-18 | Semi-active radar | | | | |
| AIM-54C | F-14 | Semi-active midcourse, active terminal radar. | | | | |
| AIM-120 | F-15/16/14/F/A-18 | Command inertial, active terminal radar. | | | | |
| Case 2: | | | | | | |
| AIM-9M | F-15/16 | See above | | | | |
| AIM-7M[2] | F-15/14/F/A-18 | See above | | | | |
| AIM-54C | F-14 | See above | | | | |

| Missile | Aircraft | Guidance type | Maximum range (NM) |  | Survival/ Break-Away Range (NM)[1] | F-Pole (NM)[1] |
|---|---|---|---|---|---|---|
|  |  |  | Head-On[1] | Tail[1] |  |  |
| AIM-120 | F-15/16/14/18 | See above |  |  |  |  |

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[1] Deleted for security reasons.

[2] Dependent upon aircraft illuminator.

Note: Due to the launch and leave capability of AMRAAM, it probably will never be used in the fly-through-intercept mode which must be used for the AIM-7. Survival/breakaway range entries in the above matrix reflect AMRAAM launch-and-leave employment which assumes an aircraft maneuver of a 6 G turn through 180° when AMRAAM is within the active acquisition range of [deleted]. The F-pole entries reflect the aircraft flying at the target until the point of missile intercept.

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# UNIT COST COMPARISON RECURRING FLYAWAY COST

## (AF ONLY/$ IN THOUSANDS)

**AMRAAM**

| FY 78$ | FY 84$ |
|---|---|
| 146 | 251 |

**AIM-7M***

| FY 78$ | FY 84$ |
|---|---|
| 107 | 184 |

*BASED ON DEC 84 SAR

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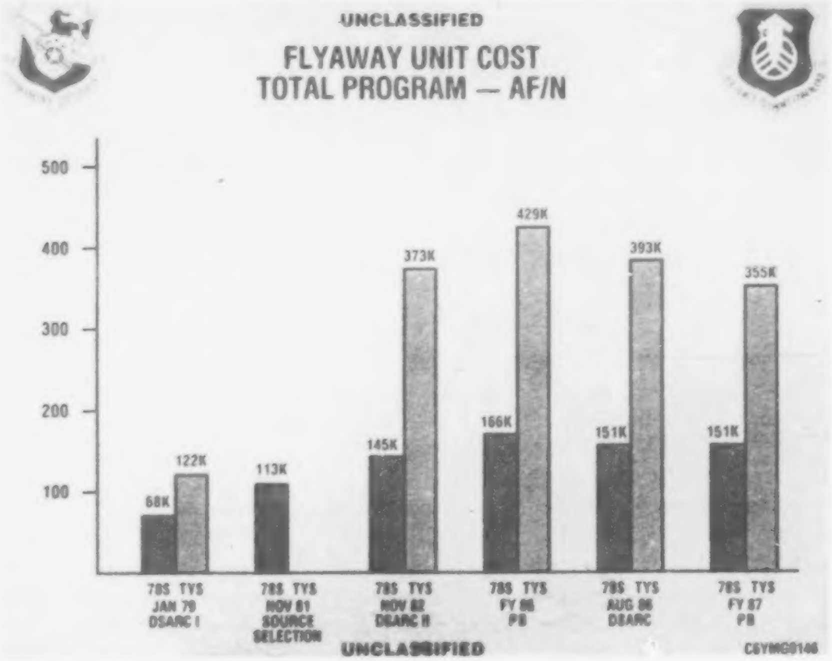
Dr. COOPER. We will do that, and add that to this chart, but the missile that we are replacing with the AMRAAM is the current generation radar missile, which is a good one, but not launch and leave. It is the AIM-7, and the most current version of that is the AIM-7M, and General Ferguson has an apples-to-apples comparison for you here.

General FERGUSON. AMRAAM is about 40 percent more expensive than Sparrow, and that seems to be reasonable, since what we are putting into the difference between the front ends of the missiles, where most of the costs are, is the active feature, which is a transmitter.

It is difficult, I will be frank with you, to make this kind of comparison, because the missile costs are built up differently, and procured in a different kind of sense.

Of course, AMRAAM, in this case, we are talking about an Air Force-only buy, of 17,000 missiles, derived from our SAR reports that are submitted to you every year around the December timeframe, and the AIM-7 cost comes from that SAR, and you can see about 40 percent more expensive.



Dr. COOPER. One other thing, put up your chart on the cost profile over the last few years. In some camps, AMRAAM has been made out as a disaster, and has a terrible cost record, and I don't think that is the case.

Last year, we told you there has been some cost growth in it. Mr. Battista was sitting where Mr. Bayer was 6 years ago when the Air Force said in 1978 dollars, they thought they could build an AMRAAM missile for $68,000 a copy, that is on the left.

You laughed at that, and I laughed at that, and I am not even sure that the Air Force didn't laugh at that. The program got started in 1976.

Since 1982, we have been advertising a unit price in 1978 dollars of about $145,000 a copy. That has been briefed to the committee. The committee has supported that, and in fact, up until last year, the committee has strongly supported AMRAAM.

Dr. COOPER. These are the excursions that we have gone through over the last 4 years or so. We went up to a high of about $166,000. We are back down to about $151,000. I would submit even at $166,000 we didn't like that when the price went up. But that is not a catastrophe by any stretch of the imagination.

Mr. McCurdy. The blue lines?

Dr. Cooper. The green (first bar) is base year 1978, which is where our documentation was. But it kind of shows you that yes, the cost went up.

Mr. McCurdy. My constituents paid the taxes on the additional 29 months?

Dr. Cooper. Even up there you will see that there has been an excursion. The reason it comes down to the final number there is because, quite frankly, Mr. Weinberger and you all were pushing the hell out of us over the last 2 years. We spent a tremendous amount of effort and we have got a more vigorous competition. We have the producibility investment up front, but it will yield long term gains. We are proposing, as you did in the legislation last year, to place a cap on the program at $5.2 billion. That is not without risk. The cap that you placed on the B–1 Program was not without risk, but I can tell having a cap gives you tremendous leverage in terms of stabilizing the program, and if that is the price that it takes we are willing to place the cap.

This means that each year the Air Force has to dedicate the funds to the AMRAAM Program to make sure we stay within the cap. The same thing happened to the B-1. We are building at those production rates. So I believe we can stay within the cap. There are no guarantees in life. I can't tell you the price of critical material is not going to go up with time. That may happen. But as best as we can determine right now, we have confidence that we can place the cap at $5.2 billion for 17,000 miles.

Mr. Dickinson. Are you going multiyear contract on this?

Dr. Cooper. No sir, because we are planning on competing and——

Mr. Dickinson. That won't keep you from competing, will it?

Dr. Cooper. Well, it relieves the splitup each year so each contractor we have would swing between one contractor getting 60 percent and one contractor 40 percent. I don't quite know how you would use a multiyear strategy. If it got to the point where one contactor's bid was so much better than the other, it might make sense for the Air Force to get a long-term bid and use multi-year contracts. That is the option we have in our bag of tricks.

Right now, what we would like to do, is keep vigorous head to head competition each year between the two. Hughes currently is in the lead. It is their design. We are bringing Raytheon up to speed as the follower. But I can assure you that Raytheon is breathing down the neck of Hughes right now. They feel it and I think it will be very, very vigorous competition.

Mr. Dickinson. Does the Air Force hold the data package?

Dr. Cooper. Yes sir.

Mr. Dickinson. You are going to have trouble there.

Dr. Cooper. We looked at it and asked the question: "Why don't you bring a third guy in?" It is painful to bring two in and there is not enough production volume or production rates to sustain three in the industrial base. We think we can sustain two contractors if we keep our production rates up.

Mr. McCurdy. How much change has there been in the actual system of the components work within the missile itself that will affect your overall production costs? In other words, I have been to one of the contractors, have seen their use of different materials for some basic structural components. How much latitude is there within the Air Force in the specs to make some of these changes, and if one contractor does it, is that available to the other contractors?

Dr. COOPER. Yes, it is. To answer your question, there is an awful lot going on in that area in the way of producibility and that was the outcome of the group that I headed last year to look at ways to reduce the cost of the missile. Producibility was one of those ways.

I might ask General Ferguson to amplify on that because he is very much involved in the contracts that are associated with the producibility.

General FERGUSON. There are several ways I think you can measure that. First, you look at our drawing packages and how well are they along. We were able to take the drawing package for the factory test equipment similar to some that you saw in the film and compete that package between Hughes and Raytheon. The original plan has been just to provide that equipment, have Hughes build it and just provide it directly to Raytheon. We were able to compete it and actually save dollars over the original contract in which we had competed originally between Hughes and Raytheon back in 1981.

If we look at the missile as it exists today, the drawing package consist of something on the order of 4,400 drawings. The missiles that are being delivered for flight test today represent all but 136 of those drawings. Now, we identified those drawings because I can describe them to you and the hardware will flow into the full-scale development program in the very near future as far as missiles are concerned. That drawing package has been totally transferred to Raytheon and is updated on essentially a weekly basis. Raytheon has entered it into their manufacturing process and it is successfully putting it onto their computer at Lowell, MA.

Mr. MCCURDY. Tell me again the actual production line will be established at either the contractors.

Dr. COOPER. We anticipate we will release the first long lead funding for production this summer. That will initiate the production process. The line itself, the first full production option, will be exercised sometime early next year in the April/May timeframe of 1987.

Mr. MCCURDY. Certification is not based on any experience as far as production, it is really based on what the cap says you have to perform. You are saying you can meet the cap?

Dr. COOPER. I am saying that with the best we know right now, we can. I am not complaining about the language that was put in last year. The certification does not correspond with any milestone in the program. I don't want to say it was arbitrary, but certainly the Secretary must certify March 1 or the program dies.

Mr. MCCURDY. There was some question whether there would be a program.

Mr. COOPER. I understand that. We will have more confidence in these numbers a year from now and yet more confidence a year from then. We have no alternative at this point.

Mr. McCurdy. How much investment do we have 2 years from now, the next 2 years, to get to the point where you have confidence, how much money do we have to invest?

Dr. Cooper. Let me answer it this way. We have almost $900 million invested in the program today. If we go another year and you approve this year's request, we will have another——

General Randolph. 1986 is $310 million and 1987 is about $790 million.

Mr. McCurdy. 1.1 billion dollars. We have to double the cost to get to the point where you are confident in your number?

Dr. Cooper. No, don't misunderstand. We are confident in our numbers, we will be more confident in our numbers a year from now and even more confident a year from then.

It is a very difficult thing, Mr. McCurdy. You know my view of the certification is that Mr. Weinberger is going to certify that he capped the program and intends to manage it within that cap. I don't think there is anyone that can tell you with absolute certainty what is going to happen over there next 10 years in any program. What we have told you is the Air Force is willing to make a——

Mr. McCurdy. The problem is this program has experienced great difficulty and that has been shown to us consistently, and the reason you have a cap is because of that difficulty.

Now, then you come back and the argument is still this. Congressman, you have invested nearly $1 billion in this system and we can't walk away from that investment, but before we get a more confident number, we are going another billion dollar investment. If for some reason they can't produce it within the cap, we will have $2 billion, and talk about really being sunk in——

Dr. Cooper. We understand, Mr. McCurdy. Believe me, I have programs in the Air Force right now and I am not going to tell you which one, that have a lot more difficulty in them than AMRAAM does.

Mr. McCurdy. That is really reassuring.

Dr. Cooper. It may be, but this program is being treated very specifically. We understand that the fundamental problem with AMRAAM was 2 years ago, almost to the day, when we looked at making a production decision, we concluded it was not ready for production. I think the Air Force acted responsibly and the program is now 29 months longer in development than we originally thought, but the program was on the books back in 1978. We don't think there are any great technical difficulties with the program. It is not a sick program. There is nothing wrong with the missile. Everything we have seen today is encouraging about the missile. We believe the missile will work, we believe it is producible, and we believe we can build it at the cost that we are telling you.

Mr. McCurdy. How much did the 29 months cost us?

Dr. Cooper. The 29?

Mr. McCurdy. Either numbers of missiles or in dollars?

Dr. Cooper. I would have to take that one for the record.

[The following information was received for the record:]

### COST OF AMRAAM DELAY

In January 1985, the Secretary of Defense approved the restructure of the AMRAAM full scale development (FSD) program extending the performance period from 50 to 79 months. The restructure did not reduce FSD missiles so there was no loss in terms of program assets. Since the FSD contract with Hughes Aircraft, the leader contractor, was a fixed price type contract, there was no additional cost to the government in having Hughes extend the missile development period. (We currently estimate that it will cost Hughes about $200 million over and above the $556,580,480 contract ceiling to finish development of AMRAAM.) We budgeted an additional $48.2 million in FY 87 and $16.2 million in FY 88 to fund the additional Government support costs required to extend the program for 29 months. This additional funding was transferred from existing AMRAAM total obligational authority.

That is a good question. It cost us obviously the time and the capability. We have capped the R&D program to Hughes Aircraft. It is $556 million. The words are we are holding the contractor's feet to the fire. There are some additional R&D costs accruing to the Government in order to keep the program running. We would supply that to you for the record. That is an increase. I think it is not large as far as the production program is concerned. Now that we have the competition, it has grown that much. As you all saw the numbers on the board, we showed you what the unit cost was in 1982, we showed you what we are estimating the unit cost to be in 1986. They are within a few percentages of each other.

Mr. HERTEL. Are you telling us the certification is not a certification?

Dr. COOPER. I am not telling you that at all. I am saying that nothing in life is 100 percent certain, there is always a risk associated with anything before you have 10 years in front of you.

Mr. HERTEL. What does certification, which design——

Dr. COOPER. We are going to the basic design. But the program manager can comment on that because one of the issues is, "Is the design complete?"

General RANDOLPH. Let me make one comment, Mr. McCurdy, with regard to the cost of the contract. The cost of the contract did not change. The number of missiles that were in the original contractor development are the same number of missiles that are being delivered now. There was no increase.

Mr. MCCURDY. That is because I am one of those who sat in the room and wrote the cap. People take this witness stand there everyday and tell us look, Congressman, if you stretch out this program it is going to cost you billions of dollars. Now you are telling me we stretched the program by 29 months, and you are saying it didn't really cost us.

General RANDOLPH. It cost $200 some million. Hughes Aircraft paid the bill because they goofed up. They paid the bill.

Mr. BATTISTA. You pay him now or pay him later, and there is nothing personal in these remarks, Tom, we have been friends for a long time. We have had our disagreements in the past, never being disagreeable, but you know, let's be frank about it, this cap thing——

Dr. COOPER. We were close one time.

Mr. BATTISTA. I was very democratic, the first to admit you were wrong about it.

Now, Tom, you said there is nothing certain in life. I will make one prediction you will never buy that missile for the numbers you have up on that chart. That is just based on plain old intuition and experience.

Dr. COOPER. The B-1——

Mr. BATTISTA. But remember, you invested $4.2 billion before you restaffed the program and that is what gave you confidence in the cap of $20.5 billion. We have 10 years of investment in the B-1 Program, 22,000 hours of wind tunnel testing, structural tests on 6,040. You know the history on this thing.

Dr. COOPER. Are you telling me no one can certify to that? I would ask you rhetorically why did you write that law?

Mr. BATTISTA. I will give you a very straight, candid answer, because people didn't have the constitution to terminate a program that should have been terminated, so the compromise was to write a cap and to write a certification. Now, you know as well as I do you won't be here, I won't be here, the Secretary Weinberger won't be here, when that program comes in at what it is really going to cost. I still contend you are going to spend $750,000 a copy on that missile, and I can base it on, well, I will take if I have got the internal data from both contractors, I am not going to release it here, I will take the standard labor hour rate, multiply it by the estimated number of hours, I get higher prices than you have on that chart.

I also have the bill of materials. Now, we can come up——

Dr. COOPER. We haven't built the first one yet.

Mr. BATTISTA. I am telling you what I have got downstairs. I have got the bills of materials for both contractors. I am telling you I have got their standard labor hour rate for their plants right now. I can tell you, you are not going to build that missile for that kind of money and no one is going to be around to ascertain whether or not that $5.2 million cap meant anything.

Mr. DICKINSON. I intend to be here.

Mr. BATTISTA. The members will be here.

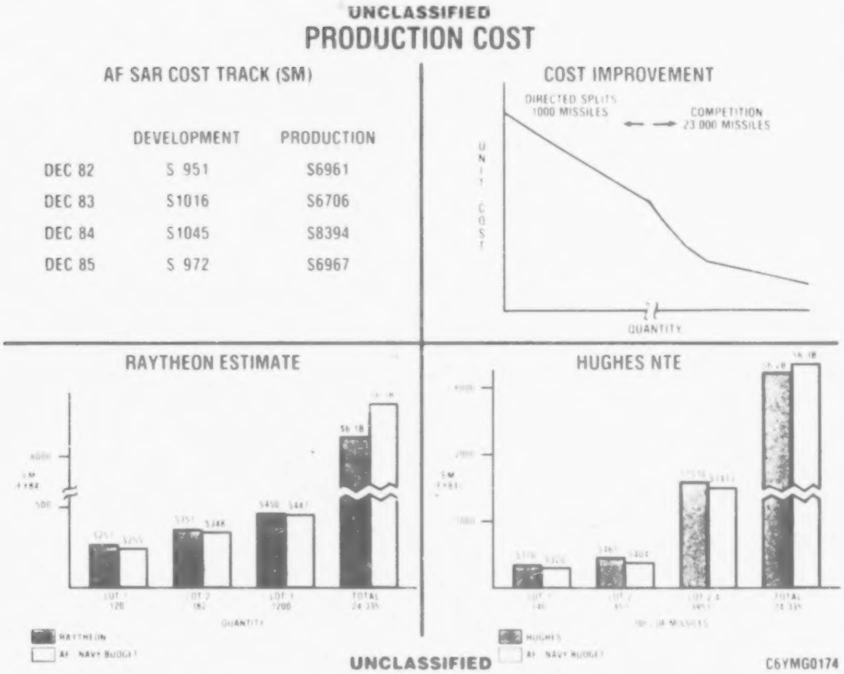
Let's send those two outside to argue and go on to the next.

Mr. HERTEL. What you are saying to us is that the certification costs in this case you are saying is not certification?

Dr. COOPER. Mr. Hertel, I can't even speak to the certification because they did not ask me to certify, they asked Mr. Weinberger to certify. I was simply giving you my opinion. I can't tell you with certainty Mr. Weinberger is going to certify. He has not done that yet. We are certainly in hopes that he will certify and I can tell you, for the last year we spent a lot, an awful lot of time with Mr. Weinberger answering the same questions Mr. Battista and others are asking us today.

All I can tell you is I think the program is very, very important to the Air Force, and I think $5.2 billion is workable, that is my judgment. Mr. Battista might care to differ with me, but I don't think either one of us can prove with absolute certainty that we are right at this point.

Mr. HERTEL. We are going to know the certification if they get certification to meet this.



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PRODUCTION COST

AF SAR COST TRACK (SM)

| | DEVELOPMENT | PRODUCTION |
|---|---|---|
| DEC 82 | S 951 | S6961 |
| DEC 83 | S1016 | S6706 |
| DEC 84 | S1045 | S8394 |
| DEC 85 | S 972 | S6967 |

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Mr. COOPER. I might mention that we do have contracts presently for the first two production options and we have not to exceed in hand for the next two production options. Of course, that is early on. The missiles have high prices there, but we believe that the learning curve that we get from that will allow them to build them at——

Mr. HERTEL. What do the contracts you talk about cost?

Dr. COOPER. I might mention while we are getting it, I can remember having similar discussions when we talked about placing the cap on the B-1 Program at $20.5 billion for 100. For 2 or 3 years people argued we couldn't meet it. Suddenly it flipped. They told us we had excess money. We have been cutting the programs for the last 2 years. We were arguing the same sort of point then. It is a judgment call.

Mr. HERTEL. Any caps that failed?

Dr. COOPER. The only cap that I can think of, Mr. Hertel, like this is the B-1.

Mr. BATTISTA. We had a Roland cap and 265 for R&D and that was Mr. Dick's amendment. The way they circumvented it, they put about $500 million worth of R&D engineering services and support in the procurement account. They met the cap only through——

Dr. COOPER. Roland is dead.

General RANDOLPH. Lantirn is capped.

Mr. BATTISTA. If I might ask, the certification that the Secretary may or may not send over is the design which you certify is completed. Does that correlate one for one with the $5.2 billion?

General RANDOLPH. Yes.

Mr. **Battista**. In other words, the missile as it is designed today, with no projected design changes, will cost $5.2 billion total program, is that correct?

General **Randolph**. No.

Mr. **Battista**. I didn't think so.

General **Ferguson**. The design that exists today is the design that is the one that we will put into production for our initial production lots. Now, we have been authorized to proceed with a cost reduction program, we call it producibility effort. Those first contracts will not be awarded until next month to both companies—Hughes and Raytheon, as well as their vendors. We are also trying to get out of the sole source situation with our critical vendor as well. Those changes don't flow into this program until our third and fourth production lot.

Since we have not let those contracts yet, for the cost reduction efforts obviously I can't certify that that design is complete, so it is based upon missiles that we will go into initial production with.

Mr. **Battista**. In other words, the Secretary, if he certifies what he is certifying is to a $5.2 billion cap based on design changes for which contracts have not been even let yet?

Dr. **Cooper**. But the second part of the certification that you asked us to do specifically addressed the producibility program and encouraged us to move out as rapidly as possible on that. Incorporating the producibility changes is one of the five points that we have to certify to. That is a separate certification.

Mr. **Battista**. That was not in the context of the design. What the intent of the legislation was, we have asked the Comptroller General for a ruling on this, is that the $5.2 billion correlate with the completed design. In other words, you have to match this to match—what we have here is a situation where we think we can save money with new design changes, accordingly based on that, we are going to certify $5.2 billion.

General **Randolph**. May I address that? It depends on your definition of the word "design." That is why I said design of the missile is complete. The missile will function exactly the way we say, and the issue that we are trying to do is how can we manufacture that more efficiently and that is what the producibility mode is for. There is no functional change.

Mr. **Battista**. What I am saying is that if you had to build 24,000 missiles based on the design that is complete today.

Dr. **Cooper**. Without producibility?

Mr. **Battista**. You would not build those 24,000 missiles or 17,000 for $5.2 billion.

Mr. **Cooper**. That is correct.

Mr. **Battista**. The other misconception I would like to clear up, this is not launch and leave, this is launch, look, and leave. That is why you have a midcourse update in there.

General **Ferguson**. The missile has three modes. The first mode you can think of as being the active mode, the missile can be launched and without any radar cueing at all, the pilot can immediately depart. It requires no updates.

The missile can then be launched in what we call an energy active mode, which means that the launch aircraft initializes the missiles, initial reference platform with target position and velocities and then once again the missile can be launched with no updates.

The third mode is what we call command inertial active and that allows, once the missile is in flight, for it to be updated with that data language message so the missile can be launched early. The launch aircraft departure depends on the battle scenario as to which would be the preferred mode as far as the attack aircraft to use depending upon what the enemy aircraft are doing. There is truly a launch and leave mode in two of the three.

Mr. BATTISTA. Is that with or without a tripod scan?

General FERGUSON. That could be in a single target track or——

Mr. HERTEL. Mr. Hutto.

Mr. HUTTO. Thank you, Mr. Chairman.

Tom, most of the R&D has been done on the AMRAAM?

Dr. COOPER. Yes, sir. I think we are about 95-percent complete in terms of the funding of it, Mr. Hutto. We still have a test program to carry out and we still have a considerable number of missiles to take delivery on.

Mr. HUTTO. Suppose the Congress decided to terminate AMRAAM, this would leave us in a pretty poor situation, wouldn't it, because the Sparrow doesn't have the range, it doesn't have the multiple target capability, so we keep buying F-15's and F-16's.

Dr. COOPER. We would have a son of AMRAAM back over post haste, I am sure.

Mr. HUTTO. If you start another program you are going to have to go through the whole R&D thing again, are you not?

Dr. COOPER. Yes, sir; plus it will come on later.

Mr. HERTEL. Other questions?

Mr. DICKINSON. I have one. What is the feasibility or the practicability of this being used to shoot down helicopters?

General FERGUSON. We are meeting the Army personnel from TRADOC, as a matter of fact, next week, sir, to talk about that specific subject. We have got three gentlemen from the Army TRADOC group coming down to talk to us about that.

Mr. DICKINSON. Well, the reason I asked the question, I am convinced in the next conventional war air superiority over the battlefield is going to be controlled for 1,500 feet down. You can come with fixed wing and drop your ordnance, you are going to be gone, he is not going to have time. Helicopters are going to control the airspace over the next conventional battlefield. They are going to have Stingers, they are going to have improved Stingers, and if they have a Chin Turret—and they have done studies on this because you come in doing 250, 300 knots, you have a window of two or three seconds, when maybe you have a helicopter in sight. By the time you can pull four "G's" or more to get around to put him back in your sight again, he has tracked you all the way around. Not to mention the Stinger, you are vulnerable, so it is going to be a very different scenario in the future from what we have known in the past and I think if we are talking AMRAAM or whatever else there is to air-to-air combat, this is going to be, should be, and must be factored into what part the helicopter plays.

I was interested to learn recently that—I might be corrected on this—I was told the standing order is if we should go to battle with helicopters, if they see Hinds turning, to get out, they can't go against the Hind, we don't have anything to go against them with. That is what is going to control the air battle airspace over the battlefield.

So it wasn't an idle question. What plans are you making, what capability does this have against the helicopter? It is a pretty expensive missile to go against a helicopter, but a helicopter costs about $12 million. So you are meeting with TRADOC and trying to work out a scenario where there is commonality, working together.

Thank you.

Mr. Battista. Just one last point.

General Ferguson, you were talking about AMRAAM modes. Let's take the first mode where you launch and leave, and put it on. From the time of launch until intercept, correct?

General Ferguson. Right.

Mr. Battista. In that mode, just ask yourself operationally if you really want to do this when you consider the power output of that front end, the fact that you are all the way around, he sees you coming, look at the aerodynamic characteristics of the AMRAAM, ascertain whether or not you want to do that or use that mode? I think operationally it is a meaningless mode. You turn that radar on that early in the game, you look at the characteristics of AMRAAM. I don't think you have a missile that is even worth that price in that mode.

General Ferguson. If we were to launch AMRAAM within its active radar mode, you are essentially within the no escape zone of the target aircraft to escape the missile. So it is a closer launch, the longer you wait to launch until you get about the range you are talking about, there really is no way either by turning to beam the missile or a complete turn that you are going to be able to escape the missile.

Mr. Battista. Well, we are in an open session here. I have looked at your simulation data, that is not what that pointed out, in fact.

You might talk to Mr. Schafer out at China Lake, who I guess headed that part of the panel on simulation data. That is quite different than the data they came up with.

So, perhaps we can do that in a separation session, OK?

General Ferguson. There is a very good article in the Navy's Top Gun journal, 1985, which I think gives a good description—of course, that is a classified journal—of the Navy Fighter Weapon School, which I would recommend as a good description, and I think it is appropriately titled "Looking Forward to AMRAAM."

There are some good tips as to how AMRAAM will really enhance the fleet fighter pilot capability.

Mr. Hertel. Thank you.

Dr. Cooper. Thank you for letting us make the presentation. We wanted to leave you with the impression there is momentum in that program, and I would also like to tell you AMRAAM is not a sick program, you may judge it too expensive, and we understand that is a judgment you have to make, but it is not a sick program directly.

Mr. Hertel. Are you going to the MX?

Dr. Cooper. I doubt that we can get all of the topics in that we have listed, we can go to a presentation on our tactical programs, advanced tactical fighter, C-17, some of our munition programs that were to be followed by a presentation on the ICBM. I don't know how long the committee wants to stay in session. If you want to change those, you can.

Mr. **Hertel**. Let's ask the members what they would like to hear.

Mr. **Dickinson**. Which ICBM?

Dr. **Cooper**. Both ICBM's.

Mr. **Dickinson**. You are trying to buy some more MX's?

Dr. **Cooper**. We are buying test missiles, 21, no warheads.

Mr. **Dickinson**. You might write a letter on that.

Dr. **Cooper**. Another letter?

Mr. **Dickinson**. You are not talking about buying any more operational missiles?

Dr. **Cooper**. Not this year.

Mr. **Dickinson**. I think not in my lifetime, either, all right?

Mr. **Hertel**. Now, what is the pleasure of the remaining members, what would you like to hear? It is a quarter to 4.

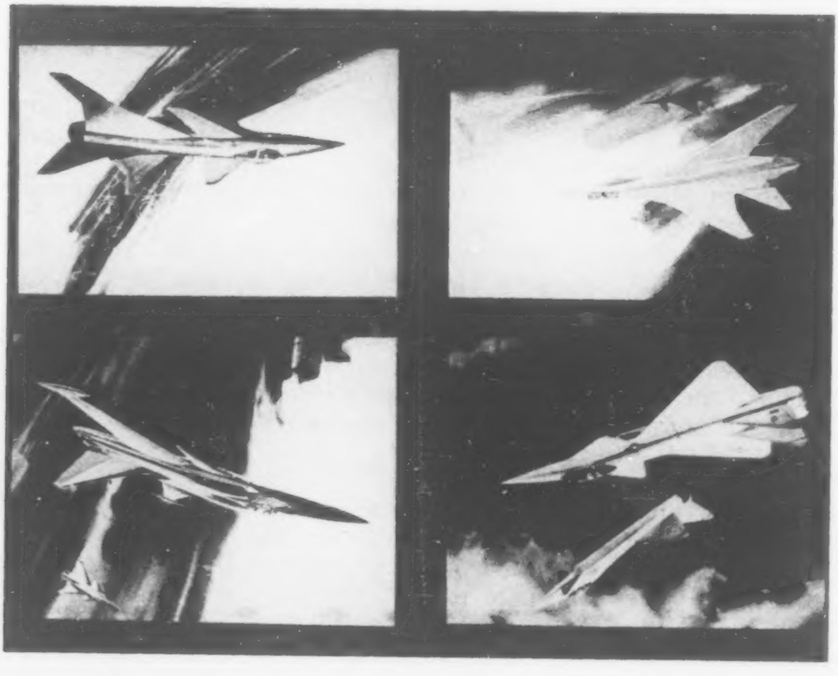
Dr. **Cooper**. We would like to make a presentation on the advanced tactical fighter.

I will introduce General Loh.

Mr. **Hertel**. Is this unclassified?

Dr. **Cooper**. Yes, sir.

## STATEMENT OF MAJ. GEN. JOHN M. LOH, USAF, DIRECTOR OF OPERATIONAL REQUIREMENTS, DEPUTY CHIEF OF STAFF, RESEARCH, DEVELOPMENT AND ACQUISITION

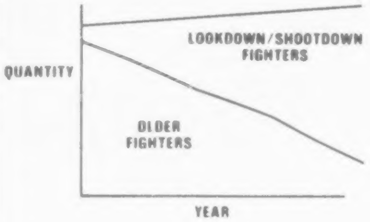


General **Loh**. Good afternoon, gentlemen, I am pleased to talk about one of our critical programs in R&D, the Advanced Tactical

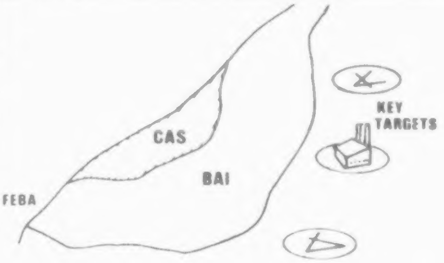
Fighter. These are national pictures of advanced tactical fighters. The actual designs, of course, are classified.

**WHY ADVANCED TACTICAL FIGHTER?**

- THREAT ADVANCES IN LOOKDOWN & SHOOTDOWN FIGHTERS/MISSILES/ RADARS



- AIR SUPERIORITY NEEDED OVER HOSTILE AIRSPACE



Very briefly, there are two fundamental reasons why we need to march out smartly with the next generation of air superiority fighter. The first is that the threat is getting a lot better, and if you look at this chart here, we will continue to have to fight outnumbered. We recognize that.

So we need to maintain qualitative superiority in our systems, but when you look at what happened to the quality advantage that we once had, you see that the Soviets are fielding a fourth generation of lookdown, shootdown fighters, and their version of AWACS, all data linked together, with aircraft that are essentially equivalent in capability to our current generation of F-15's and F-16's.

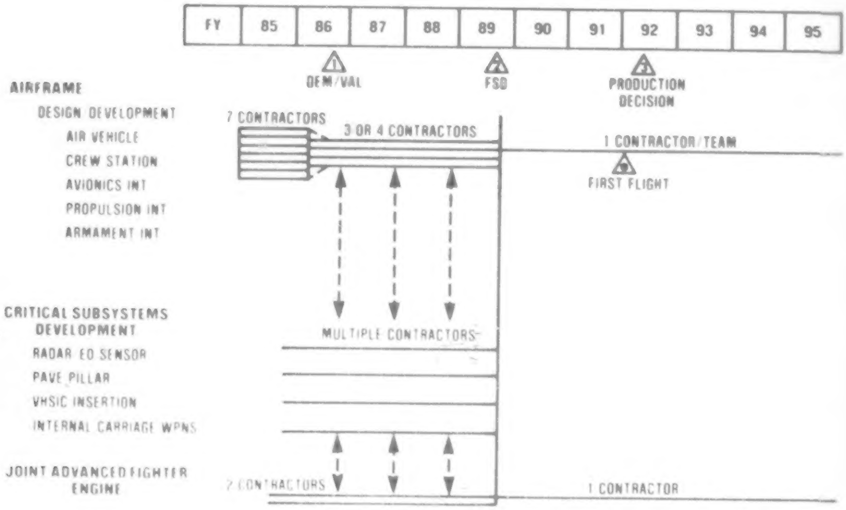
You will see that to maintain superiority in this area, we should start development of the follow-on fighter to the F-15. Mr. Chairman, that is important because in our hierarchy of missions, air superiority tends to be the most predominant because it is needed in order to fly other attack air missions over hostile territory.

We do close air support and battlefield air interdiction. All of that occurs over hostile territory, and in order to do those missions, it is vitally important, of course, that we maintain air superiority at all times, and places of our choosing.

Hence, ATF is a follow-on to F-15.

Mr. HERTEL. In the interest of time, would you mind going to the end? We will see if the members have any questions, because I think they are all very familiar with it. Tell us the state it is in, and where we are now?

General Loh. Could you go to the next to the last and last chart please, the third to the last chart, and show the schedule?



ATF
PROGRAM STRUCTURE

Right now, we have seven contractors that are bidding to enter the next phase of the program, which we call demonstration validation phase.

That is a 3-year program that will take three or four of the seven contractors that are in the ATF program right now, advance their designs through some demonstrations, and continue with the joint advanced fighter engine program.

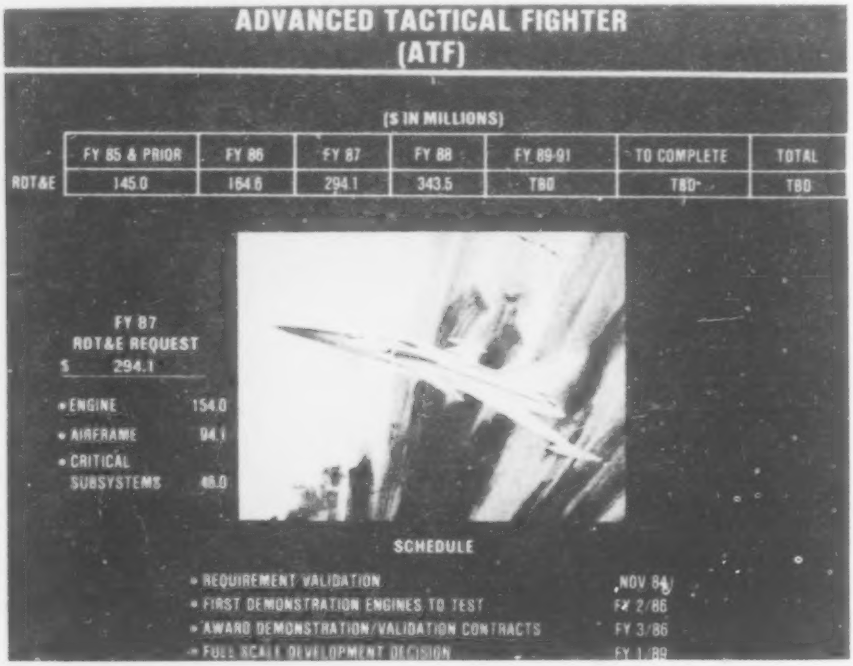
We are going right now through engine demonstration/validation between GE and Pratt-Whitney. We'll look at avionics architecture and doing some validation work. We are putting the avionics work that we need to do in terms of insertion and the electronic warfare portion, we call INEWS, and communications navigation identification portion of the program that we call ICNIA, together in a quality avionics development program.

We will do all of those over the next 36—33 to 36 months. We intend to begin that activity this summer with selection of these three or four contractors. Work continues, which is looking very good. We are going to be testing demonstrator engines from GE and Pratt and Whitney and doing subsystems development, including avionics and armaments work, all leading to the full-scale development start which doesn't begin until mid-1989.

We then enter the full-scale development program. We are not looking at any number of ATF fighters on the ramps, ready to take on those lookdown, shootdown aircraft I just described until the latter part of the 1990's, with IOC in the mid-nineties. We are in the front end of the development program that is not going to produce large amounts of these aircraft until the turn of the century.

I think that is important. Because, to get our handle around the rise of the program and the low-observable technology, the engine technology that will allow supersonic cruise and other features of the program. We need to have a solid demonstration/validation program here for these next 3 years.

That is activity that we are requesting in 1987. Next chart please.



**ADVANCED TACTICAL FIGHTER**
**(ATF)**

($ IN MILLIONS)

| | FY 85 & PRIOR | FY 86 | FY 87 | FY 88 | FY 89-91 | TO COMPLETE | TOTAL |
|---|---|---|---|---|---|---|---|
| RDT&E | 145.0 | 164.6 | 294.1 | 343.5 | TBD | TBD | TBD |

FY 87
RDT&E REQUEST
$ 294.1

| | |
|---|---|
| • ENGINE | 154.0 |
| • AIRFRAME | 94.1 |
| • CRITICAL SUBSYSTEMS | 46.0 |

SCHEDULE

| | |
|---|---|
| • REQUIREMENT VALIDATION | NOV 84 |
| • FIRST DEMONSTRATION ENGINES TO TEST | FY 2/86 |
| • AWARD DEMONSTRATION/VALIDATION CONTRACTS | FY 3/86 |
| • FULL SCALE DEVELOPMENT DECISION | FY 1/89 |

In 1987, to continue with that work, with the appropriations shown there for R&D, $294 million that will continue, the jet engine work that is critical, the airframe work in terms of structures and low-observable technology that is critical, and the avionics work that we consider necessary in order to be in a position to enter the full-scale development of the program in 1989.

Mr. HERTEL. Thank you.

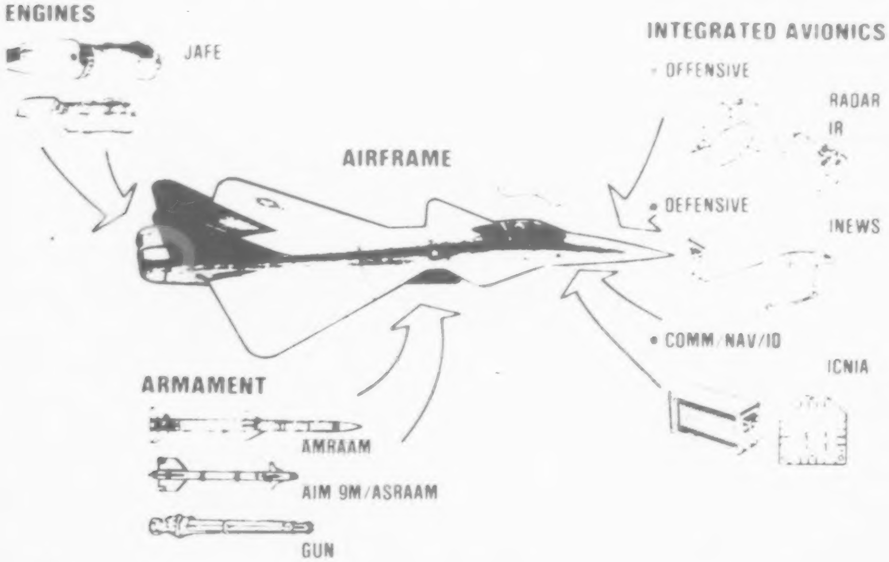
Questions? Thank you very much, General. We appreciate that.

Dr. COOPER. Might I ask you how much longer you plan to go in this session? We will adjust accordingly. What I think will be helpful, with your concurrence, is that we will submit a number of other things (ATF, C-17 and SRAM II) for the record.

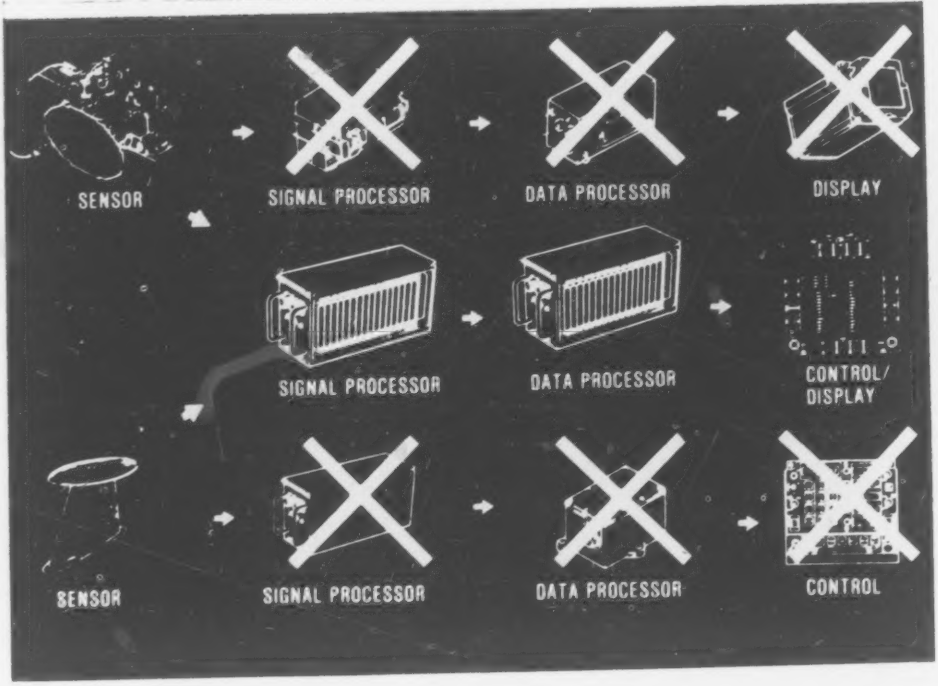
## MAJOR ATF CHARACTERISTICS

- SUPPORTABILITY INCREASE R&M/DEPLOYABILITY
- REDUCED OBSERVABLES AND PASSIVE SENSORS
- EFFICIENT SUPERSONIC CRUISE & MANEUVER
- IMPROVED GROUND SURVIVABILITY
- LONGER COMBAT RADIUS ON INTERNAL FUEL
- AFFORDABILITY
  - MEET FORCE STRUCTURE NEEDS
  - UNIT COST GOAL ESTABLISHED

## KEY COMPONENTS OF THE ATF


ENGINES
JAFE
AIRFRAME
INTEGRATED AVIONICS
• OFFENSIVE
RADAR
IR
• DEFENSIVE
INEWS
• COMM/NAV/ID
ICNIA
ARMAMENT
AMRAAM
AIM 9M/ASRAAM
GUN

## ICNIA/INEWS CONCEPT


SENSOR
SIGNAL PROCESSOR
DATA PROCESSOR
DISPLAY
SIGNAL PROCESSOR
DATA PROCESSOR
CONTROL/
DISPLAY
SENSOR
SIGNAL PROCESSOR
DATA PROCESSOR
CONTROL

## BENEFITS OF INTEGRATED APPROACH

- GREATLY INCREASES RELIABILITY
- REDUCES LOGISTICS SUPPORT COSTS
- FACILITATES FUTURE UPGRADES
- APPLIES TO JOINT SERVICE USE

## REQUIREMENTS SUMMARY

- AIR SUPERIORITY MISSION SUCCESS IS PARAMOUNT
- ATF IS THREAT DRIVEN
- ATF CHARACTERISTICS STRESS
  - SUPPORTABILITY
  - REDUCED OBSERVABLES/PASSIVE SENSORS
  - SUPERSONIC CRUISE/MANEUVER
  - SURVIVABILITY
  - LONG COMBAT RADIUS
  - AFFORDABILITY

## AIRLIFT

### THE WORLDWIDE TASKING

MOVING THE RIGHT COMBAT FORCES TO THE RIGHT PLACE
AT THE RIGHT TIME    EFFECTIVE COMBAT POWER

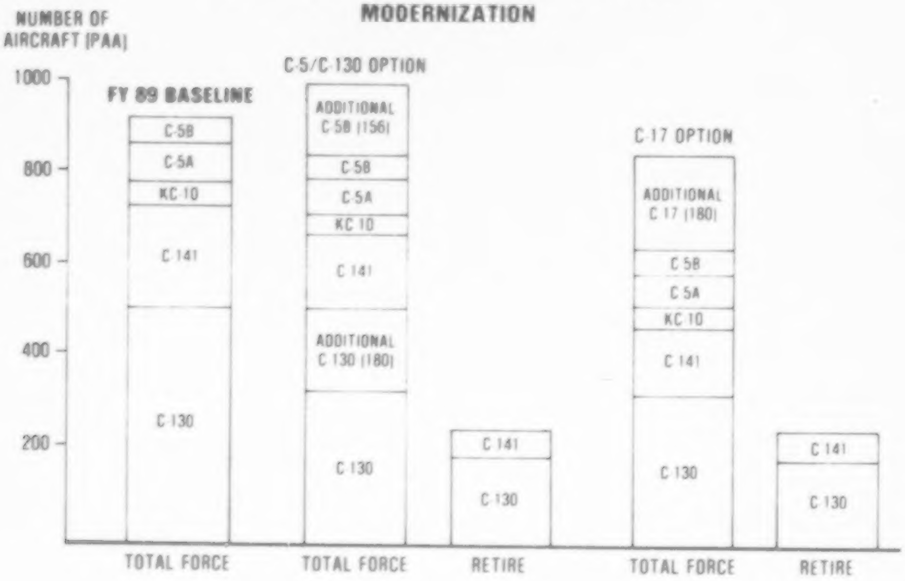
---

## CONGRESSIONALLY MANDATED MOBILITY STUDY

- RECOMMENDED 20 MILLION TON-MILES PER DAY (MTM/D) ADDITION TO FY86 CAPABILITY (46 MTM/D)
  - FISCALLY CONSTRAINED
  - 10 MTM/D TO BE OUTSIZED CAPABILITY
- 66 MTM/D HAS BEEN ACCEPTED AS OUR AIRLIFT GOAL

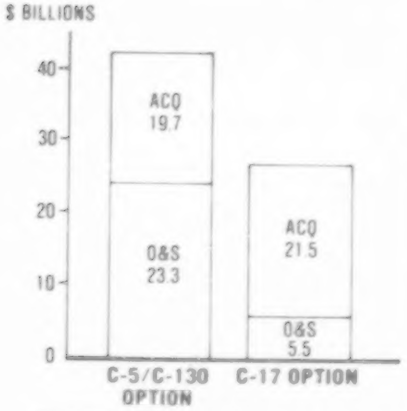
## FORCE STRUCTURE ALTERNATIVES

### MODERNIZATION



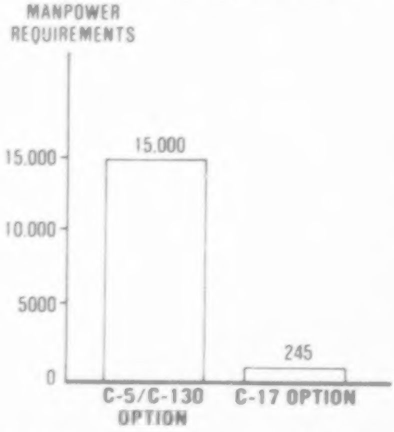
## PROGRAM COST/MANPOWER REQUIREMENT COMPARISONS

### 30 YEAR PROGRAM COST



**SUMMARY:** $16 BILLION LIFE CYCLE COST SAVINGS WITH C-17 OPTION

### MANPOWER REQUIREMENTS

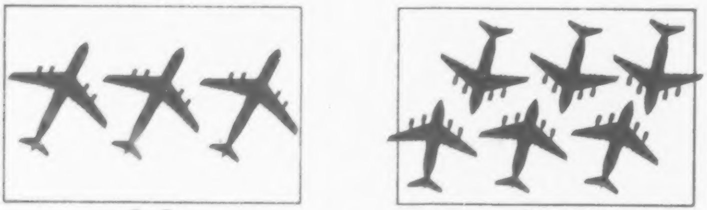


**SUMMARY:** SIGNIFICANT MANPOWER SAVINGS WITH C-17

## THROUGHPUT CAPABILITIES

| | * TONS/ACFT | X | ACFT/DAY | = | THROUGHPUT |
|---|---|---|---|---|---|
| C—5 | 97.0 | X | 22.2 | = | 2,153 T/D |
| C—17 | 86.1 | X | 64.0 | = | 5,510 T/D |

* CONUS TO EUROPE



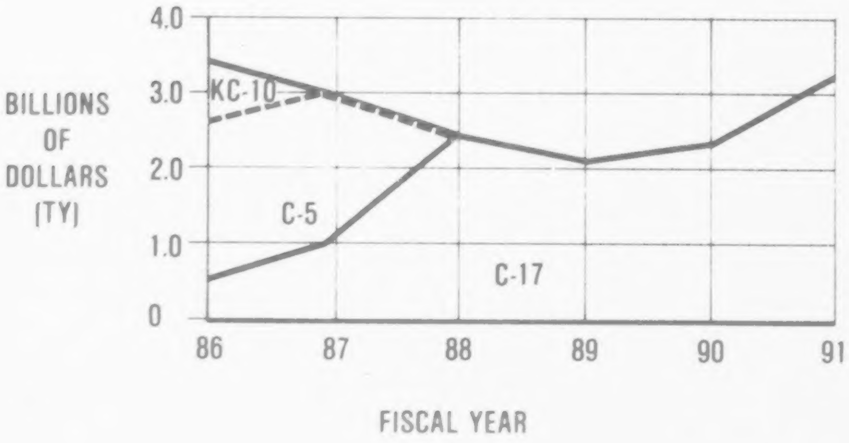
C-5s

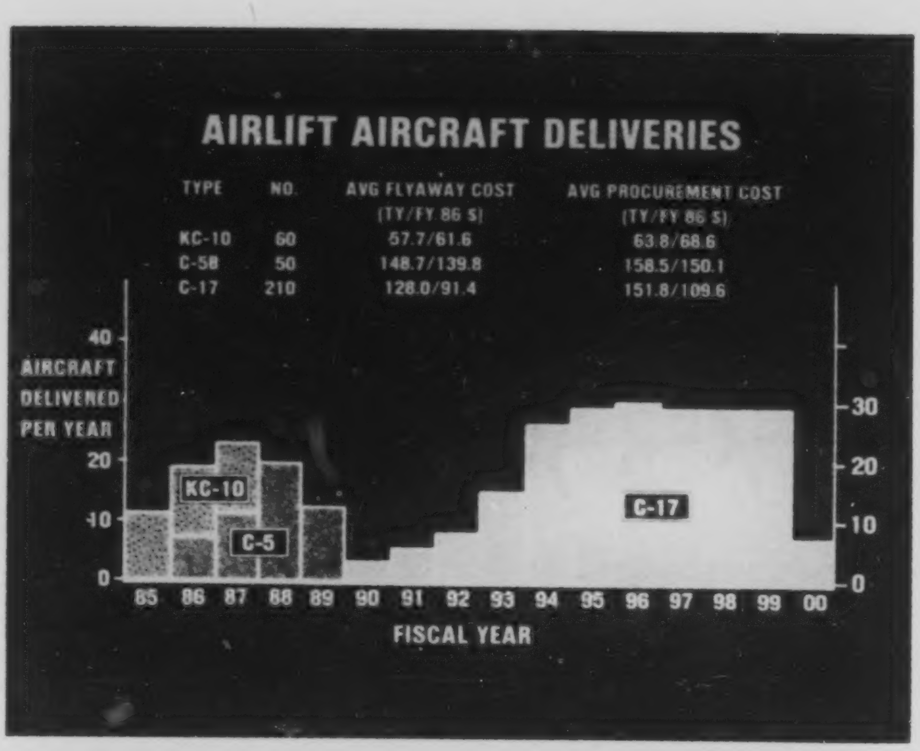
C-17s

600,000 SQ FT RAMP

**2.6 TO 1 ADVANTAGE FOR C-17**

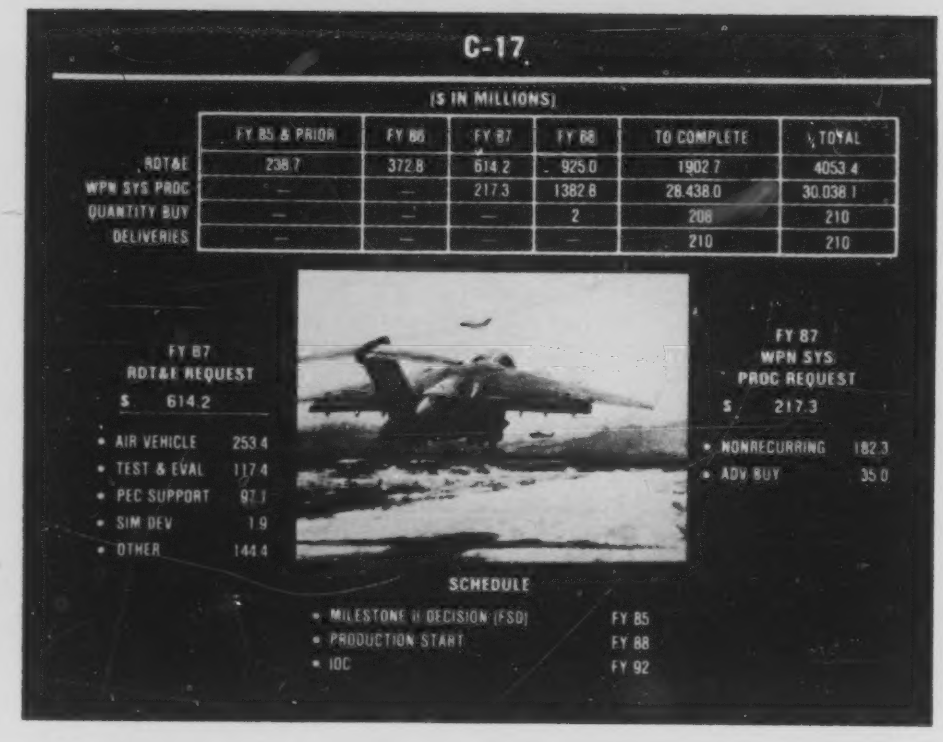
**AIRLIFT MODERNIZATION IS AFFORDABLE**





## AIRLIFT AIRCRAFT DELIVERIES

| TYPE | NO. | AVG FLYAWAY COST (TY/FY 86 $) | AVG PROCUREMENT COST (TY/FY 86 $) |
|---|---|---|---|
| KC-10 | 60 | 57.7/61.6 | 63.8/68.6 |
| C-5B | 50 | 148.7/139.8 | 158.5/150.1 |
| C-17 | 210 | 128.0/91.4 | 151.8/109.6 |



## C-17

($ IN MILLIONS)

|  | FY 85 & PRIOR | FY 86 | FY 87 | FY 88 | TO COMPLETE | TOTAL |
|---|---|---|---|---|---|---|
| RDT&E | 238.7 | 372.8 | 614.2 | 925.0 | 1902.7 | 4053.4 |
| WPN SYS PROC | — | — | 217.3 | 1382.8 | 28.438.0 | 30.038.1 |
| QUANTITY BUY | — | — | — | 2 | 208 | 210 |
| DELIVERIES | — | — | — | — | 210 | 210 |

FY 87
RDT&E REQUEST
$ 614.2

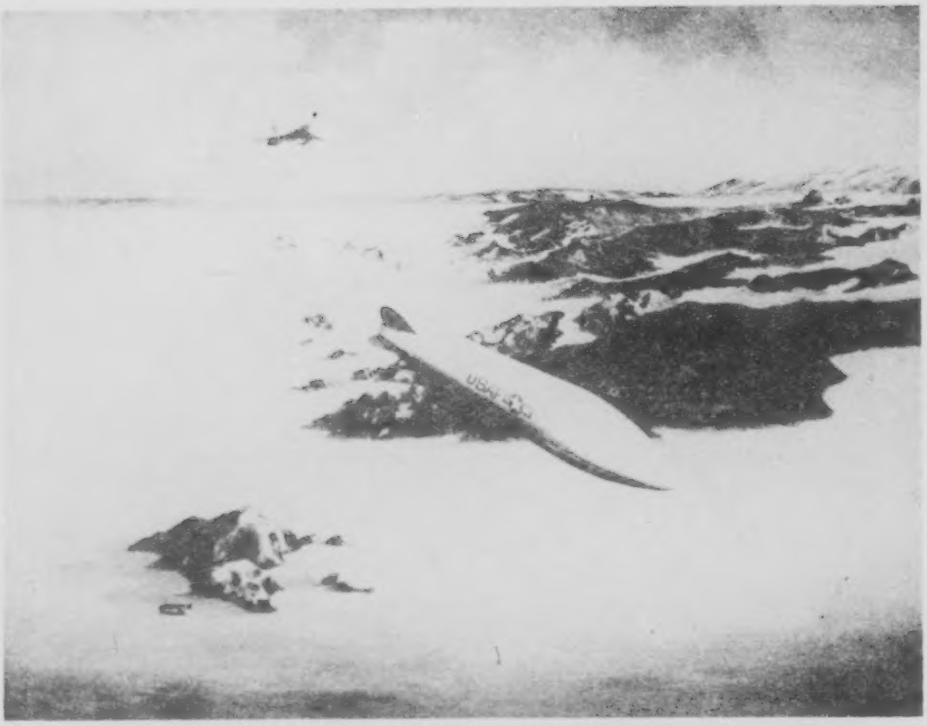
| | |
|---|---|
| • AIR VEHICLE | 253.4 |
| • TEST & EVAL | 117.4 |
| • PEC SUPPORT | 97.1 |
| • SIM DEV | 1.9 |
| • OTHER | 144.4 |

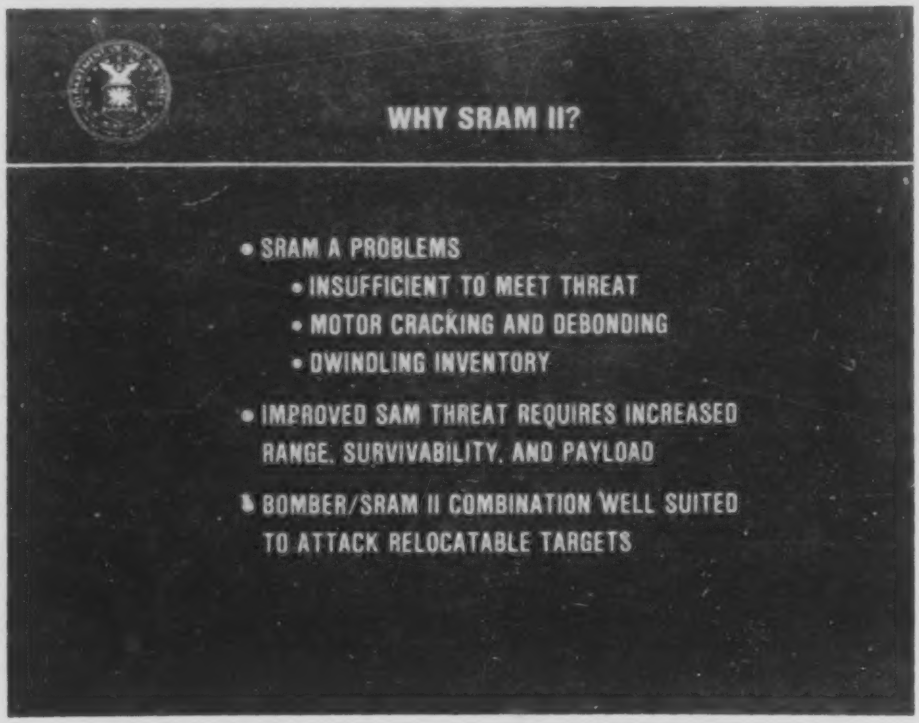
FY 87
WPN SYS
PROC REQUEST
$ 217.3

| | |
|---|---|
| • NONRECURRING | 182.3 |
| • ADV BUY | 35.0 |

SCHEDULE

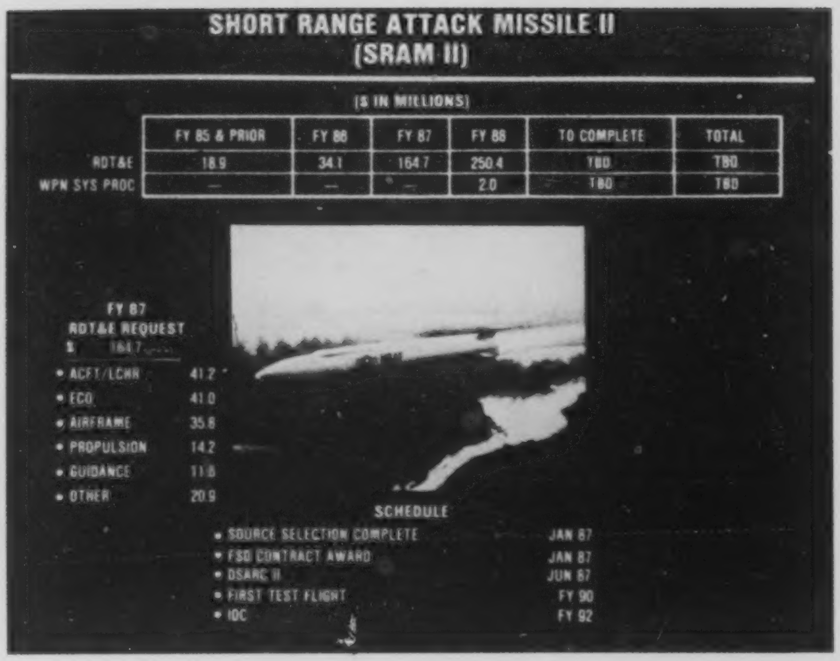
| | |
|---|---|
| • MILESTONE II DECISION (FSD) | FY 85 |
| • PRODUCTION START | FY 88 |
| • IOC | FY 92 |





## WHY SRAM II?

- SRAM A PROBLEMS
  - INSUFFICIENT TO MEET THREAT
  - MOTOR CRACKING AND DEBONDING
  - DWINDLING INVENTORY
- IMPROVED SAM THREAT REQUIRES INCREASED RANGE, SURVIVABILITY, AND PAYLOAD
- BOMBER/SRAM II COMBINATION WELL SUITED TO ATTACK RELOCATABLE TARGETS



## SHORT RANGE ATTACK MISSILE II (SRAM II)

($ IN MILLIONS)

| | FY 85 & PRIOR | FY 86 | FY 87 | FY 88 | TO COMPLETE | TOTAL |
|---|---|---|---|---|---|---|
| RDT&E | 18.9 | 34.1 | 164.7 | 250.4 | TBD | TBD |
| WPN SYS PROC | — | — | — | 2.0 | TBD | TBD |

FY 87
RDT&E REQUEST
$ 164.7

| | |
|---|---|
| • ACFT/LCHR | 41.2 |
| • ECO | 41.0 |
| • AIRFRAME | 35.8 |
| • PROPULSION | 14.2 |
| • GUIDANCE | 11.6 |
| • OTHER | 20.9 |

SCHEDULE

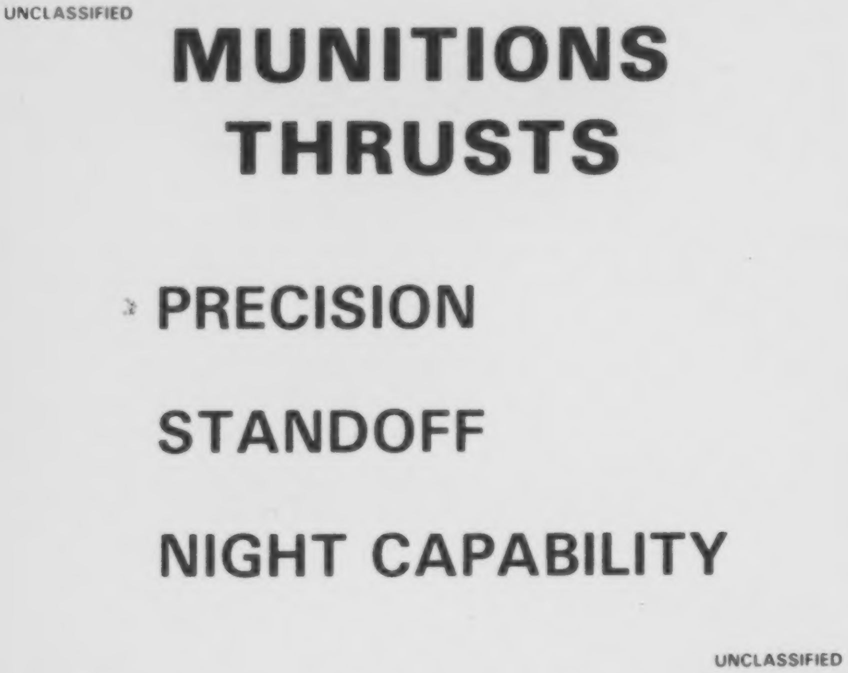
| | |
|---|---|
| • SOURCE SELECTION COMPLETE | JAN 87 |
| • FSD CONTRACT AWARD | JAN 87 |
| • DSARC II | JUN 87 |
| • FIRST TEST FLIGHT | FY 90 |
| • IOC | FY 92 |

General Monahan has a very short presentation, along with a tape on what we are doing in the munitions area. There is no real issue here. There may be the issue on affordability again. There is no real problem here, but I think it would be interesting for the subcommittee to see some of the efforts that we have ongoing there.

I would suggest we switch immediately to General Monahan and let him go through that.

**STATEMENT OF MAJ. GEN. GEORGE L. MONAHAN, JR., USAF, DIRECTOR OF DEVELOPMENT AND PRODUCTION, DEPUTY CHIEF OF STAFF, RESEARCH, DEVELOPMENT AND ACQUISITION**

General MONAHAN. Good afternoon. The first chart shows the thrust of our munitions program, not only for fiscal year 1987, but also looking out into the future, covering the period of the next 5 years and beyond.



UNCLASSIFIED

MUNITIONS THRUSTS

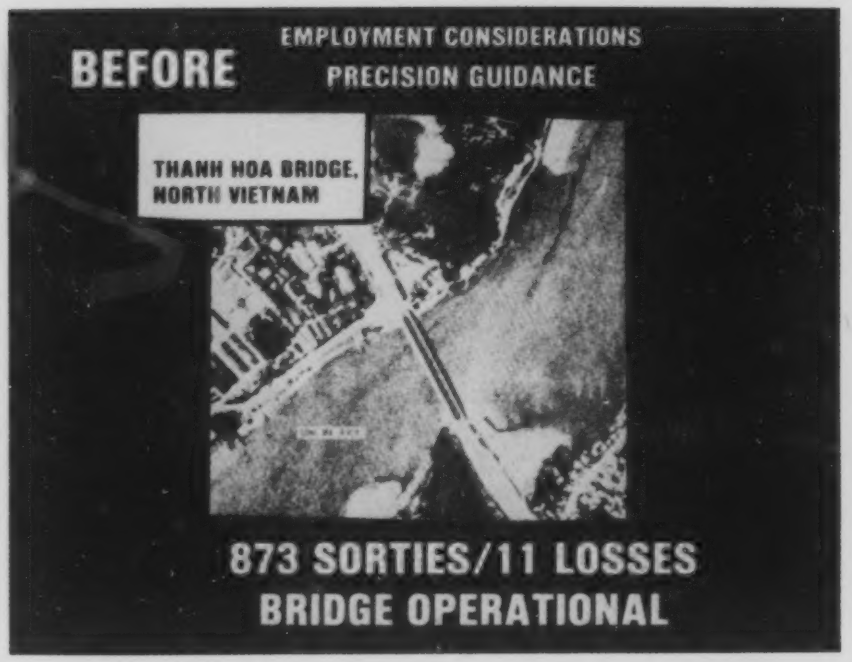
PRECISION

STANDOFF

NIGHT CAPABILITY

UNCLASSIFIED

Precision, such that we don't need to fly as many sorties to do the same sort of job. Standoff, such that we don't have to expose our attack aircraft to terminal defenses. Night, so that we can utilize our fighter and attack airplanes over a much broader window as far as the daylight and night is concerned, especially in Europe.



EMPLOYMENT CONSIDERATIONS
PRECISION GUIDANCE

**BEFORE**

THANH HOA BRIDGE,
NORTH VIETNAM

873 SORTIES/11 LOSSES
BRIDGE OPERATIONAL

Here is a good reason why we are so interested in precision and standoff capability. Real-life experience here on a bridge in North Vietnam, 873 sorties, we lost 11 airplanes, the bridge was damaged, but still operational.

AFTER

EMPLOYMENT CONSIDERATIONS

PRECISION GUIDANCE

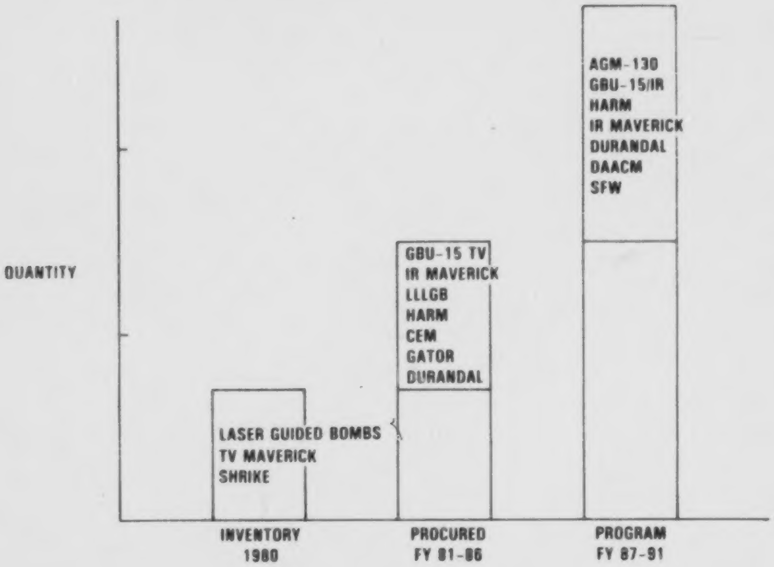
HOA BRIDGE,
VIETNAM
1972

8 SORTIES/0 LOSSES

BRIDGE DESTROYED

We then employed our early models of laser guided bombs against the bridge, and with just eight sorties, no losses, we were able to destroy the bridge, a good example of the advantages of the precision type munition or what we call preferred munitions.

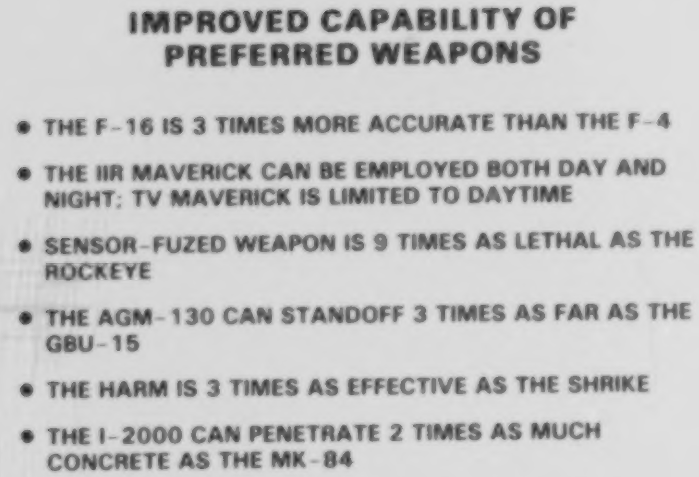
## PREFERRED MUNITIONS



In 1980, here is the sorts of munitions we had that were in the preferred category: Laser guided bombs, TV Maverick, Shrike that went after enemy air defense units.

Since then we have gone from the laser guided bomb to the low-level guided bomb. We can stand off three times as far with that weapon as we could with the earlier one. We have the infrared Maverick that helps us operate at night, TV Maverick obviously is limited to day, and with the AGM-130 right here, we will be able to operate or to deploy this guided weapon about three times as far in standoff range as we can the GBU-15, which was its predecessor.

You see the rapid buildup in quantity then over the period of the next 5 years.



## IMPROVED CAPABILITY OF PREFERRED WEAPONS

- THE F-16 IS 3 TIMES MORE ACCURATE THAN THE F-4
- THE IIR MAVERICK CAN BE EMPLOYED BOTH DAY AND NIGHT: TV MAVERICK IS LIMITED TO DAYTIME
- SENSOR-FUZED WEAPON IS 9 TIMES AS LETHAL AS THE ROCKEYE
- THE AGM-130 CAN STANDOFF 3 TIMES AS FAR AS THE GBU-15
- THE HARM IS 3 TIMES AS EFFECTIVE AS THE SHRIKE
- THE I-2000 CAN PENETRATE 2 TIMES AS MUCH CONCRETE AS THE MK-84

Our increased capability is also a function of the increased accuracy of attack airplanes. The F-16 is three times as accurate in dive bombing as the F-4 that it replaces. The sensor fused weapon has about nine times the lethality of the Rock Eye, as far as killing armored type targets is concerned.

You can read off these. We have even been working the problem of being able to penetrate fortified structures with our new I-2000 bomb. It has twice the capability to penetrate concrete over the Mark 84.

I have a short film clip that I would like to show. What you are going to see are munitions that are already in production.

Dr. COOPER. Before you start, maybe we can kill the lights one more time?

Mr. DAVIS. What has happened to the triple LGB program?

Dr. COOPER. As you may recall, Mr. Davis, we had authorization and appropriation to procure 5,000-plus of the LLLGB. We are going to procure those for the 2,000-pound bomb program. Beyond that, there was no money in the budget last year, and there is no money in the budget this year and beyond for the LLLGB. It has been canceled. The price went up and Mr. Orr made the decision it should be terminated. We will buy it out at 5,000-some that we had money for, and that is it.

Mr. BATTISTA. On that, Dr. Cooper, you have got several thousand, I think, Mark 82, still in the inventory the Navy has the Skipper program. From the test results, the Skipper really performed well within the envelope of the LLLGB.

Do you think Air Force is interested in extending its capabilities of getting some Skipper kits?

Dr. COOPER. I can't commit to that right now. That is obviously an option if the Navy has it in production. Again, we canceled the other one for affordability. That is something we can take a look at. Right now, we have no plans to use the LLLGB with the 500-pound bomb.

General MONAHAN. Let's roll the film. This is GBU-15, launched off an F-4. The operator is looking through the TV cameras.

Dr. COOPER. A glide bomb, not powered.

General MONAHAN. And he is going to come and hit this truck. Here it is against a bunker. Here is another one using an infrared sensor, this time against that same bunker.

Here we are against a simulated radar van. Incidentally, in exercises we have had the controlling aircraft standing off over 80 miles, able to direct the weapon upon the target.

This just shows the IR scene on the bottom, and TV scene on the top. We can use either type of sensor with the GBU-15.

Dr. COOPER. We were 10 for 10, were we not?

General MONAHAN. Yes, this was FOT&E. These are side views of the 2,000-pound bomb hitting the target.

Next is a laser-guided bomb, but more importantly, it is a hard target 2,000 pound munition. You are going to see this scoring a direct hit here on the bunker. You can very vividly see the sort of damage that it does. It goes inside, penetrates, before it explodes.

This is a 6-foot-tall pole right here and gives us some measurement of what it did to the concrete bunker. This is an IIR Maverick operating at night against a truck, it is launched after it is locked on, the operator doesn't have to do anything, it automatically guides onto the target.

That was an IR Maverick right there.

Here we have the F-111, which is going to disperse the combined effects munitions.

These are Gator mines, anti-tank mines. We are procuring the Gator at the present time. An armored vehicle rolls over the mine—the sort of thing that can happen to it is the tread can come off. For example, that is what happened there.

Here, you see the effects of a munition canister being dropped from an F-16.

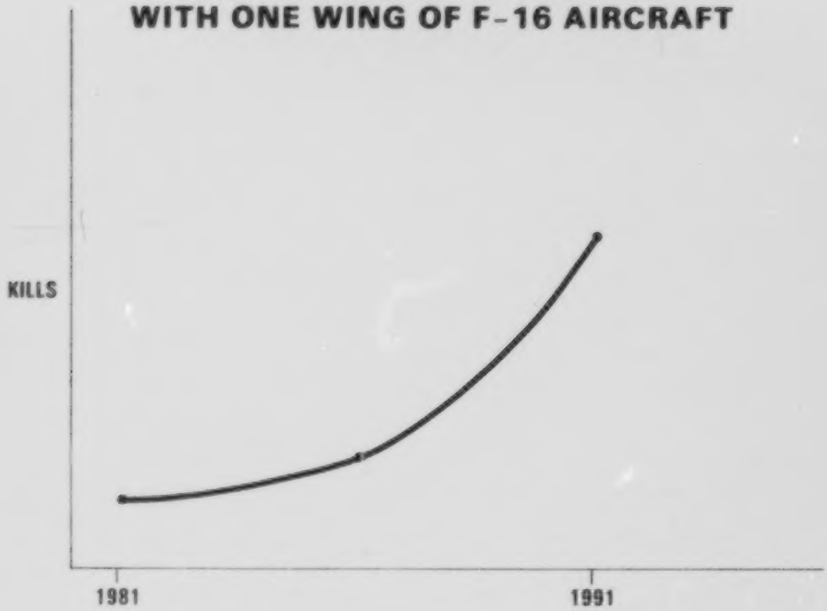
Dr. COOPER. This one will ruin your whole day if you are in the way of it.

General MONAHAN. 202 bomblets, which have armored penetrating capability, antipersonnel fragmentation capability and incendiary—you will see them all hit. They fuze on impact. That one canister covers an area a little bit bigger than a football field.

Mr. BATTISTA. That is CBU-87.

General MONAHAN. Combined effect munitions. Thank you.

TARGET KILLS ACHIEVABLE
WITH ONE WING OF F-16 AIRCRAFT



Just two charts to wrap this up.

Mr. BATTISTA. You said you had an 80-mile acquisition.

General MONAHAN. Not an acquisition; the controlling aircraft was standing back 80 miles.

Mr. BATTISTA. You had a data link, or——

General MONAHAN. Data link, the controlling airplane can stand back as far as he can see, have direct line of sight, and get the TV signal back from the bomb. We actually did that (from 80 miles) in our exercises out in Nevada.

What does it add up to for us? If I take one 72 aircraft wing of our F-16 airplanes, these are the target kills that we can get out of the wing of airplanes over a 60-day period I have left the numbers off the chart, be happy to furnish them to keep this unclassified.

Down here, there is about a fivefold increase in the effectiveness of the one wing of F-16's by pursuing the program we have laid out between now and 1991.

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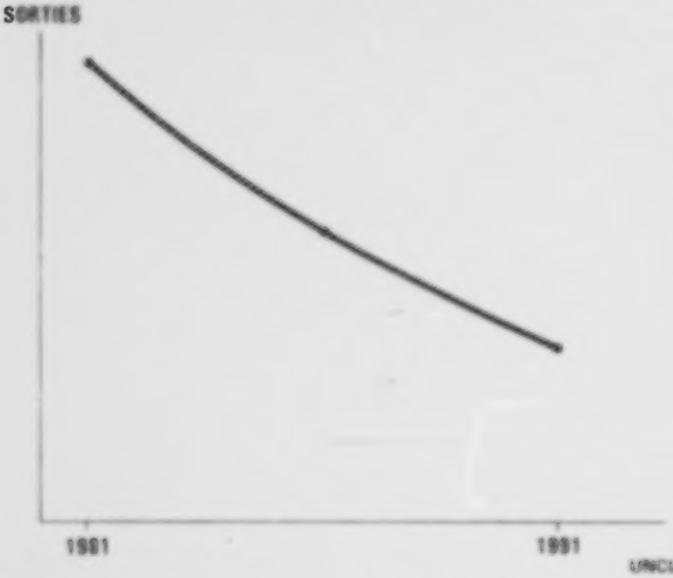
**SORTIES REQUIRED TO KILL ARMOR TARGETS**



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Another way to look at it, is like this: In sorties required to kill a set of armored targets, in this case, 16,000 armored targets. The sorties required are reduced by two-thirds. In other words, out here 1991 will take about one-third the number of sorties as it would require back in 1980. Chart off.

That concludes the presentation. We can talk about any specific programs or any questions you might have.

Mr. HERTEL. Thank you very much.

Dr. COOPER. Mr. Hertel, if it is your pleasure, we can go through the ICBM modernization quickly, if you would like, or supply it for the record? There are no technical issues with either MX or small missile at the present time that we would need to discuss with you, technically they are both doing very well.

We recognize the political issues, we can discuss that for hours, I am sure.

Mr. HERTEL. I think we have the discussion with Dr. Hicks, we have some questions for the record, unless members have some questions at this time.

Mr. Dickinson agreed we have had a pretty full discussion before.

Dr. COOPER. If I could gain your permission to put the additional information in the record, we would like to do that.

Mr. HERTEL. Sure.

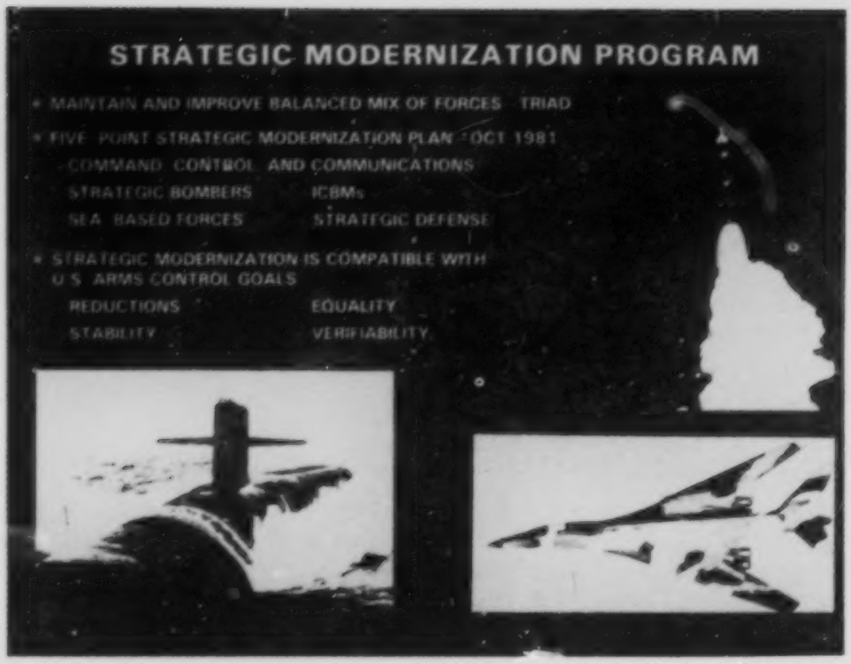
PREPARED STATEMENT OF BRIG. GEN. CHARLES A. MAY, JR., DEPUTY DIRECTOR AND SPECIAL ASSISTANT FOR ICBM MODERNIZATION DIRECTORATE OF OPERATIONAL REQUIREMENTS

Mr. Chairman, members of the committee, it is my pleasure to be here today to report on the ICBM Modernization Program. We have continued to make progress in all areas of the program during 1985 and in early 1986. In my role as the Special

Assistant for ICBM Modernization. I would like to share that progress with you and also outline our request for FY 87.

U.S.
ICBM
MODERNIZATION
PROGRAM

Our current ICBM Modernization Program is part of the five point strategic modernization plan begun in the early part of this administration. The objective of this plan is to modernize our strategic TRIAD. This includes the ICBM's, the strategic bombers, the sea-based forces, our command and control and communications as well as strategic defense. And of course our strategic modernization objectives go hand-in-hand with our arms control objectives which are to achieve equitable and verifiable reductions toward the long term goal of increased strategic stability.



## STRATEGIC MODERNIZATION PROGRAM

- MAINTAIN AND IMPROVE BALANCED MIX OF FORCES TRIAD
- FIVE POINT STRATEGIC MODERNIZATION PLAN OCT 1981
  - COMMAND CONTROL AND COMMUNICATIONS
  - STRATEGIC BOMBERS
  - ICBMs
  - SEA BASED FORCES
  - STRATEGIC DEFENSE
- STRATEGIC MODERNIZATION IS COMPATIBLE WITH U S ARMS CONTROL GOALS
  - REDUCTIONS
  - EQUALITY
  - STABILITY
  - VERIFIABILITY

In 1983, the President's Commission on Strategic Forces was convened to review our strategic force modernization needs and in particular to look at the needs of the ICBM modernization leg of the TRIAD. The commission recognized three aspects of ICBM modernization. First was the need to increase our hard target countermilitary capability to begin to offset the large Soviet advantage in this area resulting from the Soviet ICBM build-up and hardening programs begun in the early 70s. The second aspect is that of the vulnerability of our existing silos to this increasing Soviet capability. Third, the recognition that our existing ICBM force is beginning to age. Minuteman II was deployed in the 1960s, Minuteman III in the early 1970s. Both of these systems have exceeded their original design life. As this force continues to age, it is important for us to deploy new systems which protect against any catastrophic age-related failures which could degrade our overall deterrent credibility.

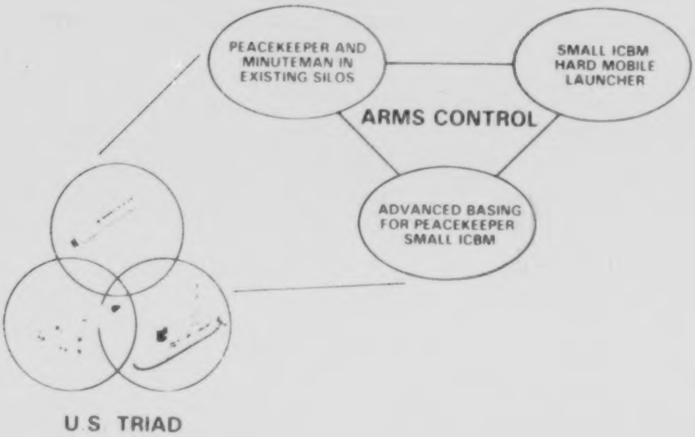
UNCLASSIFIED

## SCOWCROFT CONSENSUS REMAINS THE BLUEPRINT FOR ICBM MODERNIZATION

| U.S. ICBM MODERNIZATION | | SCOWCROFT OBJECTIVES |
|---|---|---|
| • COUNTERMILITARY CAPABILITY | → | • PROVIDE PROMPT HARD-TARGET DETERRENT CAPABILITY |
| • VULNERABILITY TO INCREASING SOVIET CAPABILITY | → | • INCREASE ATTACKER UNCERTAINTY |
| • AGING FORCE | → | • PROVIDE LAND-BASED HEDGE AGAINST FUTURE SLBM VULNERABILITIES |

The Commission identified objectives for ICBM modernization which include (A) upgrading our flexible response deterrent capability by providing the ability to threaten the Soviets most highly valued strategic war-fighting assets, (B) structuring our force to increase the attackers uncertainty, i.e., "to confuse and confound and complicate" and thereby deter any potential attack plan, and (C) the commission recognized the need to enhance the survivability of the land based leg to help provide a hedge against any future vulnerabilities in the other components of the TRIAD.

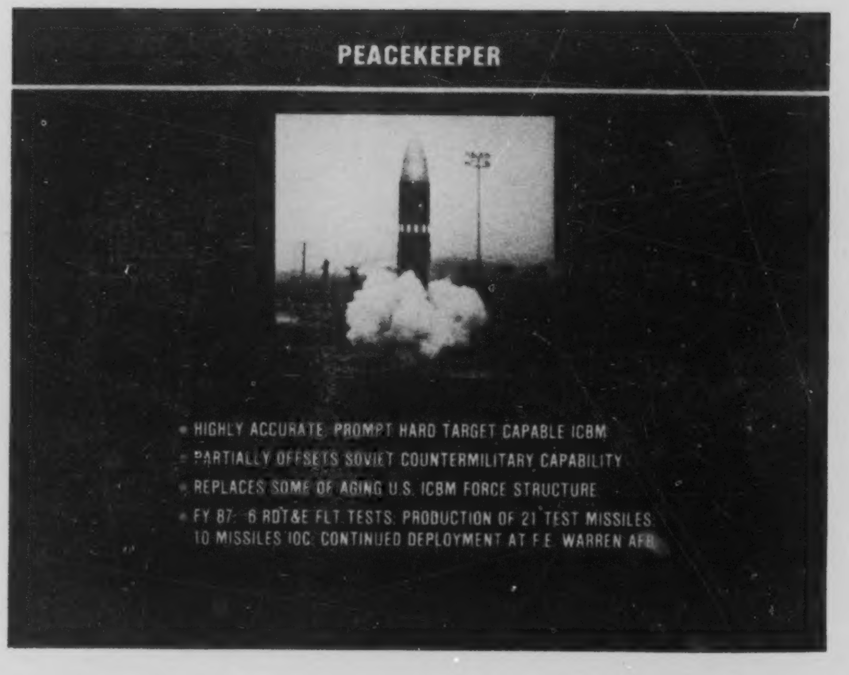
## U.S. ICBM MODERNIZATION PROGRAM


PEACEKEEPER AND MINUTEMAN IN EXISTING SILOS
SMALL ICBM HARD MOBILE LAUNCHER
ARMS CONTROL
ADVANCED BASING FOR PEACEKEEPER SMALL ICBM
U.S. TRIAD

A major finding of the commission was that by trying to solve these separate ICBM tasks with a single weapon system in a single basing mode, we had made the problem of modernizing the force so complex as to be "virtually insoluble." As a consequence, the commission recommended a three part program. The first part was to deploy initially 100 Peacekeepers in existing Minuteman silos to enhance our prompt hard target deterrent capability in the near term. The second part was to deploy a small single warhead ICBM with survivability and stability in the longer term. And last, to conduct a follow-on basing technology program to provide long term survivability. These recommendations were accepted by the President, approved by the Congress and continue to be the roadmap for our ICBM Modernization Program.

FY 86 Congressional action to limit the deployment of Peacekeepers in existing silos and to pursue a more survivable basing mode for the second 50 Peacekeepers has given new impetus to the Advanced Basing Technology effort recommended by the Scowcroft Commission. We continue to have a requirement for 100 Peacekeepers and the deployment of a credible number of SICBMs to hold at risk a significant portion of the Soviet target base. We believe there is great promise in our advanced basing efforts for a future deployment of Peacekeeper in an alternate basing mode—subject to the approval of Congress—and also for follow-on SICBM deployments.

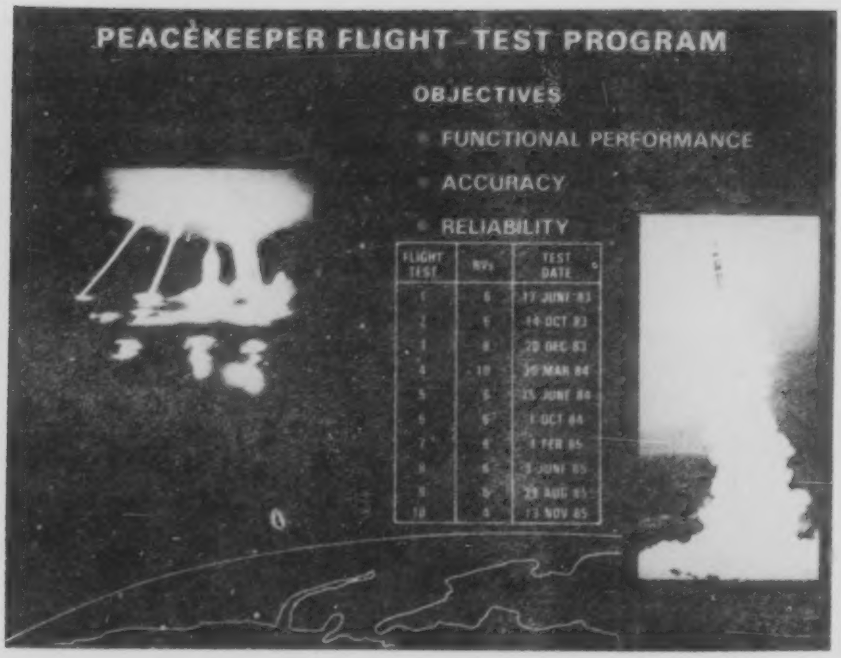
Today, I would like to talk to you about our progress and our plans in all three of these areas. Peacekeeper, Small ICBM development and our advanced basing technology program.



PEACEKEEPER

- HIGHLY ACCURATE, PROMPT HARD TARGET CAPABLE ICBM
- PARTIALLY OFFSETS SOVIET COUNTERMILITARY CAPABILITY
- REPLACES SOME OF AGING U.S. ICBM FORCE STRUCTURE
- FY 87: 6 RDT&E FLT TESTS, PRODUCTION OF 21 TEST MISSILES, 10 MISSILES IOC, CONTINUED DEPLOYMENT AT F.E. WARREN AFB

We are very proud of our accomplishments in the Peacekeeper program. As you know, Peacekeeper provides our ICBM leg the unique capability, to threaten those key Soviet warfighting assets which are highly hardened and today are in virtual sanctuary status. In this role, Peacekeeper will begin to offset the large Soviet countermilitary capability. The 50 Peacekeepers authorized for deployment will replace 50 Minuteman III missiles in the 400th Strategic Missile Squadron at F.E. Warren AFB. Since this is a one for one replacement of missiles, there is no net change in the number of U.S. ICBM missile launchers. However, we will upgrade the force with 500 highly accurate reentry vehicles, a net increase of 350 considering the removal of the Minuteman III which carry three warheads each. While significantly enhancing our deterrent capability, this deployment will also begin to hedge against any potential age related failures in our existing Minuteman II or III force.



PEACEKEEPER FLIGHT TEST PROGRAM

OBJECTIVES

- FUNCTIONAL PERFORMANCE
- ACCURACY
- RELIABILITY

| FLIGHT TEST | RVs | TEST DATE |
|---|---|---|
| 1 | 6 | 17 JUNE 83 |
| 2 | 6 | 14 OCT 83 |
| 3 | 8 | 20 DEC 83 |
| 4 | 10 | 30 MAR 84 |
| 5 | 5 | 15 JUNE 84 |
| 6 | 6 | 1 OCT 84 |
| 7 | 4 | 1 FEB 85 |
| 8 | 6 | 5 JUNE 85 |
| 9 | 6 | 23 AUG 85 |
| 10 | 4 | 13 NOV 85 |

In 1985, we continued to make outstanding progress in our flight test program. We conducted four more Peacekeeper launches bringing the total to 10. The last two of these flights, FTM-9 and 10 were launched out of an operationally configured MM III silo from Vandenberg AFB. Both of these launches were highly successful, increasing our confidence in our ability to deploy the Peacekeeper in modified operational Minuteman silos. All 10 of our flight tests have been highly successful, demonstrating the superb functional performance of the Peacekeeper and its outstanding accuracy, which is considerably better than our goal. Peacekeeper has been a real technical success story and ranks as the finest ICBM development program to date.

PEACEKEEPER PROGRAM STATUS

PRODUCTION UNDERWAY
(54 MISSILES AUTHORIZED)

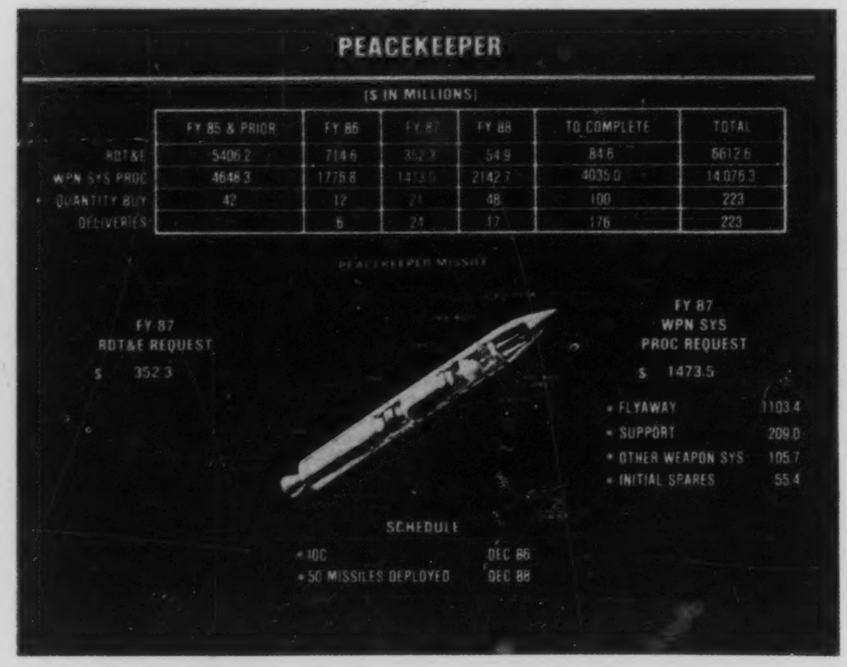
- RDT&E FLIGHT TESTS
  50 PERCENT COMPLETE

- CONSTRUCTION AT F. E. WARREN
  ON SCHEDULE FOR IOC

- FIRST MISSILES OPERATIONAL
  SEPT 1986; IOC
  (10 MISSILES) DEC 1986

The missile production program continued in 1985. With the 12 missiles authorized in FY 86, we now have a total of 54 missiles authorized. Fifty of these are designated for deployment in existing Minuteman silos, the remaining 4 are to be used in our operational test and evaluation program. As you know, our operational test program involves removing an alert missile from a silo, removing the nuclear warheads, transporting the "non-nuclear" system to Vandenberg AFB, insert in a test silo and launch it for test data. Simultaneously, it is replaced on alert by a spare missile which has the nuclear warheads, removed from the missile to be tested, installed on its fourth stage.

Our R&D flight test program has completed 10 of 20 launches. Construction of facilities at F.E. Warren AFB is now over 75% complete and on schedule for our December 1986 initial operational capability. The first production missiles will be delivered to F.E. Warren AFB in May of this year. We have begun removing the first several Minuteman III missiles to be replaced with Peacekeepers later this year. The first two missiles should be on alert this fall, and we will achieve our initial operational capability of 10 missiles on alert by December of 1986. We view this as a significant accomplishment because it was a goal set more than 8 years ago, and we have remained on schedule in spite of 4 basing mode changes during that period. The excellence of these accomplishments are reflected in the selection of Major General Aloysius G. Casey, the commander of the Ballistic Missile Office, to receive the Eugene M. Zuckert Management Award for outstanding program management in 1985 for keeping this program on track and within budget while accomplishing all technical objectives.



## PEACEKEEPER

($ IN MILLIONS)

| | FY 85 & PRIOR | FY 86 | FY 87 | FY 88 | TO COMPLETE | TOTAL |
|---|---|---|---|---|---|---|
| RDT&E | 5406.2 | 714.6 | 352.3 | 54.9 | 84.6 | 6612.6 |
| WPN SYS PROC | 4648.3 | 1776.8 | 1473.5 | 2142.7 | 4035.0 | 14076.3 |
| QUANTITY BUY | 42 | 12 | 21 | 48 | 100 | 223 |
| DELIVERIES | | 6 | 24 | 17 | 176 | 223 |

PEACEKEEPER MISSILE

FY 87
RDT&E REQUEST
$ 352.3

FY 87
WPN SYS
PROC REQUEST
$ 1473.5

| | |
|---|---|
| • FLYAWAY | 1103.4 |
| • SUPPORT | 209.0 |
| • OTHER WEAPON SYS | 105.7 |
| • INITIAL SPARES | 55.4 |

SCHEDULE

| | |
|---|---|
| • IOC | DEC 86 |
| • 50 MISSILES DEPLOYED | DEC 88 |

Our FY 87 request includes $352.3M for RDT&E and another $1473.5M for production. These funds will continue our FY 87 R&D program—leading to 50 missiles begin deployed by December of 1988—and procures 21 test missiles and associated initial spares.

The twenty-one test missiles are in accordance with FY 86 Congressional action which limited FY 87 procurement to between 12 and 21 test missiles "depending upon the most efficient production rate." Our production experience shows that 21 is clearly the more efficient rate and will save about 25% in unit flyaway cost versus the less efficient rate of 12. Also, the 21 missiles are strictly test missiles—no warheads are being procured for them. Ultimately, we will need 123 test missiles to support the Peacekeeper over its design service life.

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## FY 87 PEACEKEEPER RDT&E TASKS

- SIX DEVELOPMENT FLIGHT TESTS
- R&D PROPULSION CONTRACTS COMPLETE
- FINAL NUCLEAR HARDNESS AND SURVIVABILITY TESTS
- BASING SUPPORT EQUIPMENT COMPLETE
- TECH ORDERS (TOs) COMPLETE

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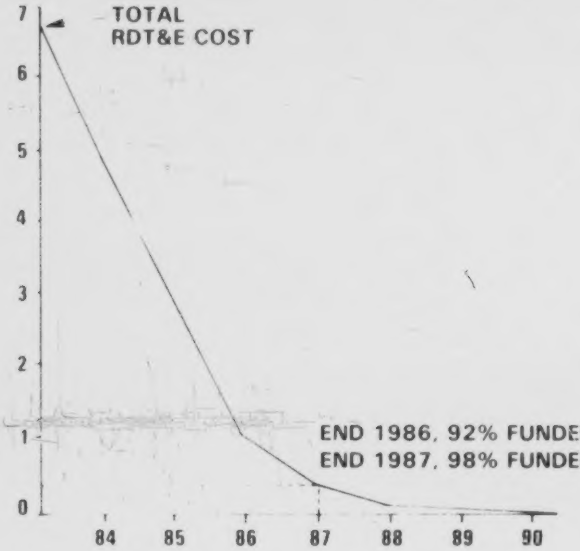
The FY 87 RDT&E request provides funding to complete the last 6 RDT&E flight tests, the RDT&E propulsion contracts, and final nuclear hardness and survivability testing. This funding also completes final development of basing support equipment and tech orders.

## PEACEKEEPER RDT&E FUNDING STATUS

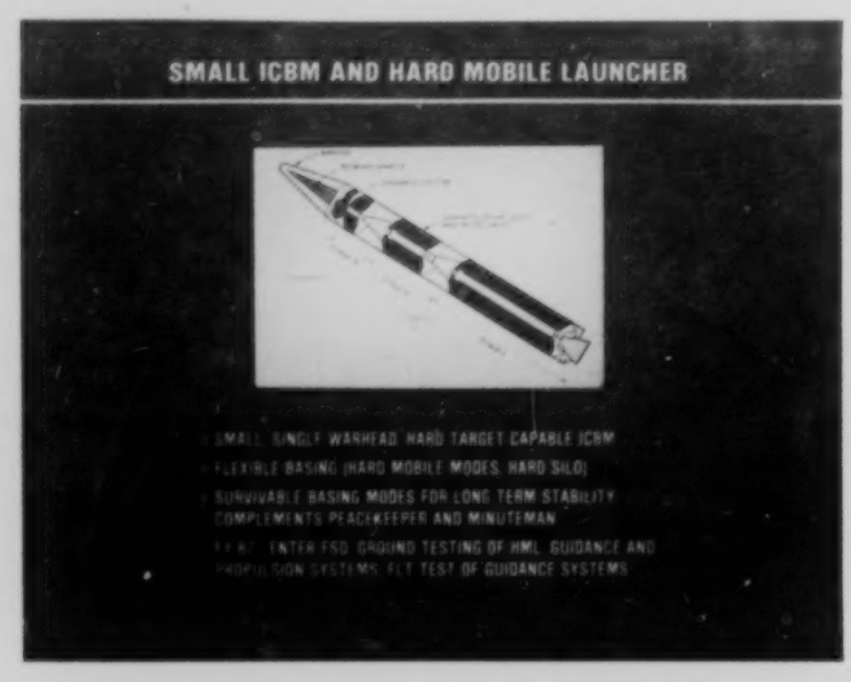
(BILLIONS OF THEN-YEAR DOLLARS)



As you can see, with the 1986 authorization, we are 92% funded in our Peacekeeper R&D program. With your support of our 1987 request, we will be 98% funded, with only a few remaining tasks to complete in FY 88.

We are also past the halfway mark in total program funding. With the FY 86 authorization, Peacekeeper was 60% funded. With the FY 87 request, we will be 70% funded. So the bulk of the financial commitment is behind us now.

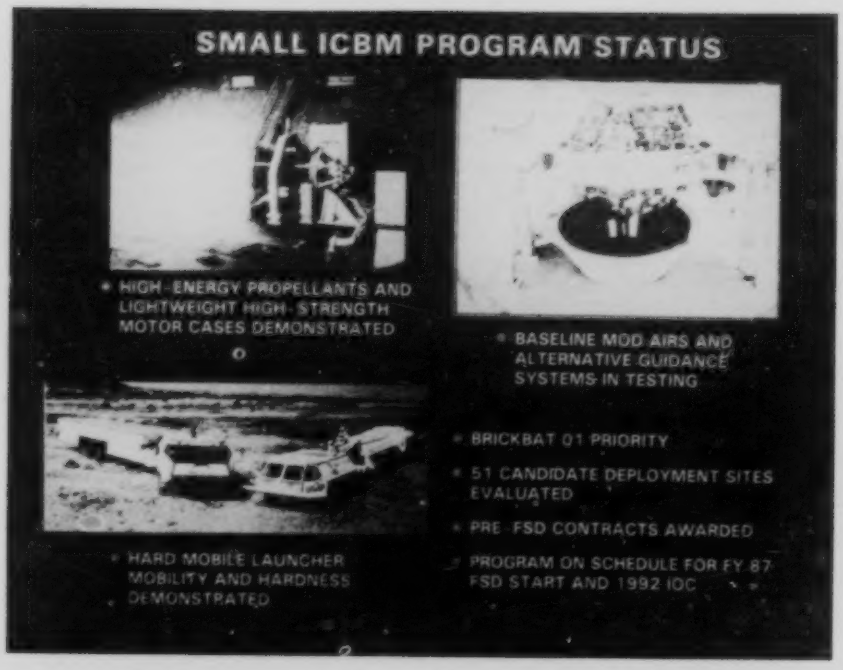
We would like to point out that the Congress has been a partner with us in this outstanding development by providing sufficient funding to complete the required tasks at a manageable level of risk. We believe that by properly funding the program, we have been able to keep the program on schedule, accomplish all technical objectives and maintain some measure of stability in the development. We have appreciated Congressional support in this regard.



SMALL ICBM AND HARD MOBILE LAUNCHER

- SMALL, SINGLE WARHEAD, HARD TARGET CAPABLE ICBM
- FLEXIBLE BASING (HARD MOBILE MODES, HARD SILO)
- SURVIVABLE BASING MODES FOR LONG TERM STABILITY COMPLEMENTS PEACEKEEPER AND MINUTEMAN
- FY 87: ENTER FSD, GROUND TESTING OF HML, GUIDANCE AND PROPULSION SYSTEMS, FLT TEST OF GUIDANCE SYSTEMS

**The Small ICBM, the second part of the Scowcroft program, complements Peacekeeper and our existing Minuteman forces by adding a small, single warhead, hard target capable ICBM, suitable for deployment in a number of survivable basing modes including mobile and fixed.**



## SMALL ICBM PROGRAM STATUS

- HIGH-ENERGY PROPELLANTS AND LIGHTWEIGHT HIGH-STRENGTH MOTOR CASES DEMONSTRATED
- BASELINE MOD AIRS AND ALTERNATIVE GUIDANCE SYSTEMS IN TESTING
- HARD MOBILE LAUNCHER MOBILITY AND HARDNESS DEMONSTRATED
- BRICKBAT 01 PRIORITY
- 51 CANDIDATE DEPLOYMENT SITES EVALUATED
- PRE-FSD CONTRACTS AWARDED
- PROGRAM ON SCHEDULE FOR FY 87 FSD START AND 1992 IOC

We have made significant progress with the SICBM and hard mobile launcher in this past year. The Air Force completed Phase I of the acquisition process and began Phase II which is pre-full scale development. Contracts have been awarded for weapon system assembly, test and system support, and missile propulsion, hard mobile launcher and guidance system development. The latter category includes the 3 alternate inertial navigation system (AINS) contracts which provide cost and performance competition for the baseline inertial measurement unit, the MOD AIRS, the basic system used on Peacekeeper.

The propulsion design phase began in February 86, with the award of contracts to two competing companies for each of the three stages. Each contractor continues to validate the technologies to meet baseline performance for the SICBM. Successful full scale motor firings demonstrated the feasibility of high energy propellants. Motor case burst tests validated the use of lightweight, high strength motor cases made of graphite epoxy fiber. Each contractor will be test firing 3 full-scale size prototype SICBM motors as well as burst testing from 3-8 motor cases in 1986.

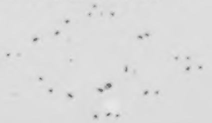
In the guidance area, we are continuing a vigorous competitive acquisition. We are using the modified advanced intertial reference sphere (MODAIRS) which is a hybrid of the highly successful guidance unit on the Peacekeeper, as the baseline SICBM guidance system. We are also evaluating 3 competing advanced inertial navigation systems (AINS): one stellar inertial system and two ring laser gyro designs. Our initial testing, which includes component testing and sled tests, shows that the performance of all three competitors continues to be better than expected. Through this competitive guidance acquisition, we expect to realize a significant savings in the cost of each guidance unit

With respect to the hard mobile launcher, 2 of 4 hard mobile launcher contractors were competitively selected to continue work during the pre-FSD phase. Their studies and tests confirm that a hard mobile launcher, hardened to 30 pounds per square inch or greater is technically feasible. This is based on concept evaluations using scale models in blast tube testing and also a nuclear blast simulation test (minor scale event) which was conducted above ground in 1985. Both hard mobile launcher contractors, Boeing and Martin Marietta Corporations, have constructed full size mobility test vehicles, shown here, which have completed field tests at contractor facilities and have been turned over to the Air Force for further testing this year. Results to date indicate with confidence that we can achieve the required levels of mobility and hardness in the hard mobile launcher.

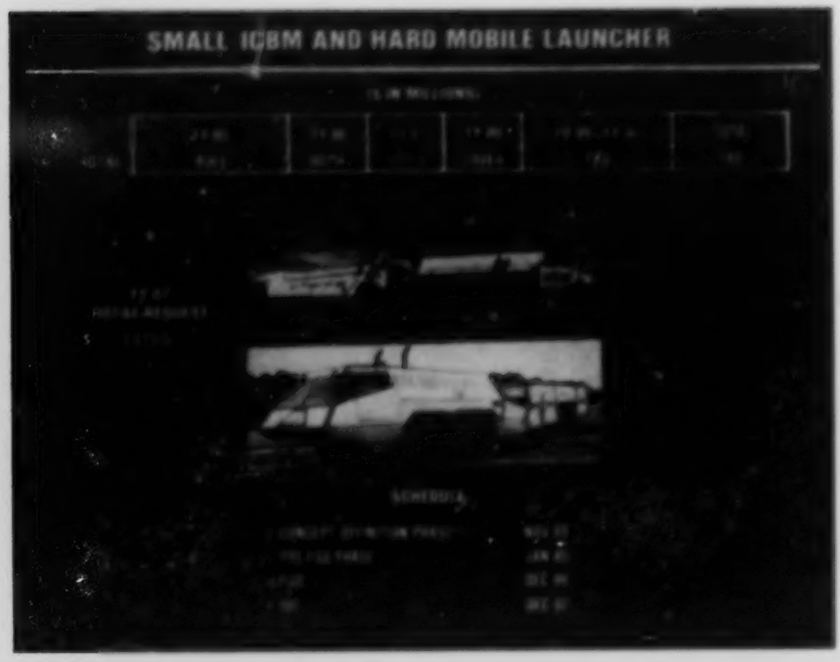
As you can see, the SICBM acquisition program is characterized by major competition in all phases of the weapon system development. This will lead to a firm weapon system baseline design to support entry into full scale development late this year, leading to missile flight testing in early 1989 and IOC in 1992.

In order to assist the area selection and basing mode decision associated with entering full scale development, the Air Force is preparing a legislative environmental impact statement (LEIS) which will address potentially significant environmental impacts which may result from deploying the SICBM. To date, 4200 installations have been screened, 51 sites were studied in depth and we have recently eliminated all but 24 candidate sites which include the six existing Minuteman facilities. These sites will be evaluated this year for potential mission conflicts and continued suitability in preparation for a basing mode and area selection decision late this year. The program is on schedule for a full scale development start in FY 87 in order to meet the 1992 Congressionally mandated IOC.

## BASING CONCEPTS

| | |
|---|---|
| HARD ROAD MOBILE<br> | DEPLOY ON DOD DOE LAND<br>HARDNESS AND MOBILITY FOR SURVIVABILITY<br>30 PSI OR GREATER HARDNESS |
| SUPERHARD SILO | DEPLOY ON EXISTING MINUTEMAN SITES OR NEW AREAS WITH GOOD GEOLOGY<br>FIXED AND MOBILE CONTROL CENTERS<br>SITE SECURITY LIKE MINUTEMAN |
| HARD MOBILE LAUNCHER ON EXISTING SILO SITES<br> | DEPLOY ON EXISTING MINUTEMAN LAUNCH FACILITIES<br>RAPID DISPERSAL AT HIGH DEFCON LEVELS<br>SITE SECURITY LIKE MINUTEMAN |

We are currently looking at three separate basing modes for the Small ICBM IOC. The baseline concept is the hard mobile launcher deployed on existing DOD/DOE installations. The operational concept employs a strategy of periodic random movement within a deployment area that is large enough to complicate enemy planning and targeting. During times of increased tension, the hard mobile launchers are dispersed over an area approximately twice as large as the day-to-day deployment area. The launchers would leave the deployment installations only under conditions requiring attack dispersal. We are also evaluating a superhard silo in patterned array basing mode which could be deployed in new areas offering beneficial geology. The silos would be over 50 times the hardness of existing Minuteman facilities and arranged to complicate enemy targeting while simplifying maintenance, security, and command and control activities. The cost of land acquisition and daily operations would thereby be reduced. In addition, deploying the hard mobile launcher on existing Minuteman facilities appears to have great promise. In this mode, the hard mobile launchers would be pre-dispersed "on alert" at selected launch facilities and would only be dispersed off of these facilities during higher states of readiness. This deployment mode would make maximum use of existing Minuteman support facilities, including maintenance, operational and security personnel.



SMALL ICBM AND HARD MOBILE LAUNCHER

The FY 87 Small ICBM RDT&E request is for $1375.5M and represents the funds needed to enter full-scale development and to initiate the level of activity necessary to meet the 1992 Congressionally mandated IOC date.

UNCLASSIFIED

## FY 87 SMALL ICBM RDT&E TASKS

BEGIN FULL SCALE DEVELOPMENT (FSD) AWARD FSD CONTRACTS

FSD DESIGN REVIEWS FOR MISSILE AND BASING SYSTEMS

TESTING OF PROPULSION AND GUIDANCE SYSTEMS

LONG LEAD MATERIAL FOR PROTOTYPE FSD VEHICLES

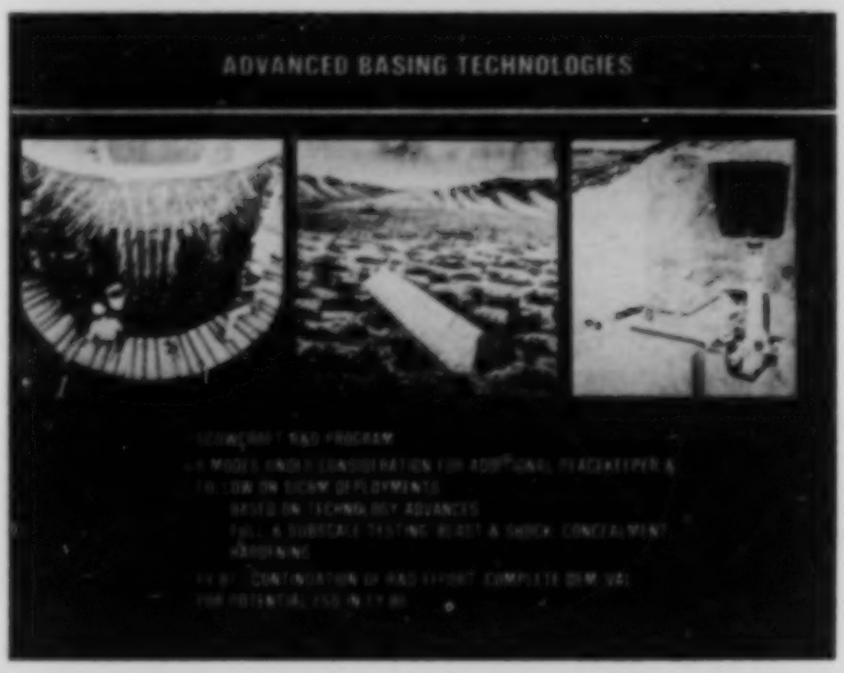
HARD MOBILE LAUNCHER HARDNESS, NUCLEAR WEAPONS EFFECTS, AND MOBILITY TESTS

MINUTEMAN FLIGHT TESTING OF ALTERNATE GUIDANCE SYSTEMS

BASING SITE SELECTION

UNCLASSIFIED

The FY 87 RDT&E request will fund the award of all full-scale development contracts; designing and testing the propulsion and competing guidance systems; conducting full scale development design reviews for all missile and basing subsystems; testing of the HML for hardness, other nuclear weapons effects and mobility; procuring long lead material for prototype full scale development HML vehicles. The funds will also allow us to conduct two flight tests of the competing SICBM guidance systems on Minuteman missiles during FY 87. More detailed site specific environmental studies leading to a final basing area selection decision are also included.



ADVANCED BASING TECHNOLOGIES

SCOWCROFT R&D PROGRAM

[illegible] MODES UNDER CONSIDERATION FOR ADDITIONAL PEACEKEEPER & FOLLOW ON SICBM DEPLOYMENTS

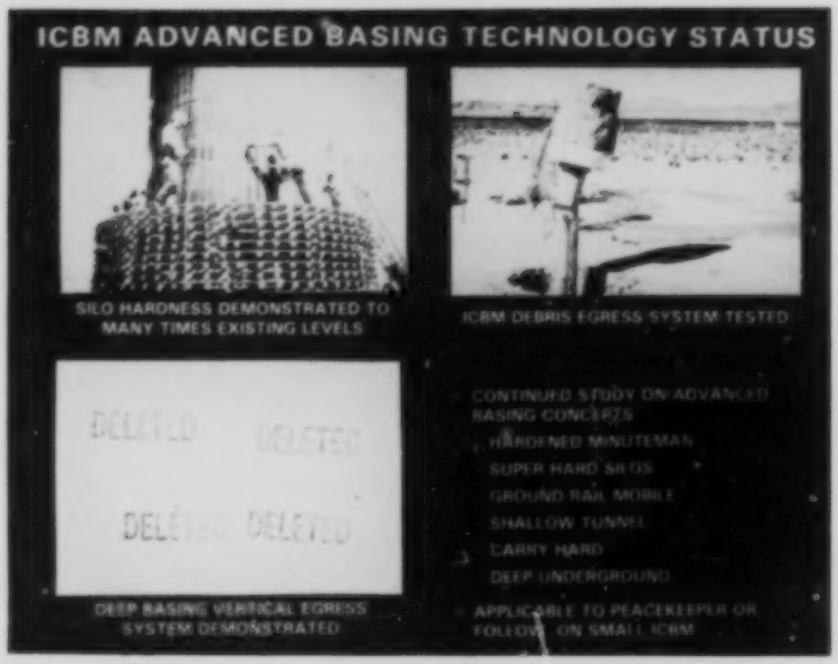
BASED ON TECHNOLOGY ADVANCES

FULL & SUBSCALE TESTING: BLAST & SHOCK, CONCEALMENT, HARDENING

FY 87 - CONTINUATION OF R&D EFFORT. COMPLETE DEM/VAL FOR POTENTIAL FSD IN FY 88

The third area of our ICBM Modernization program, the advanced basing technology program, continued to show significant progress in 1985. This program, created by the Scowcroft Commission, was started initially in 1984 as a generic program to investigate ICBM basing technology which would lead to long term survivability enhancements for the ICBM force. To date, these efforts have focused on silo hardening, and deep underground basing technologies. This past year, we have expanded these efforts to include the consideration of additional basing modes which we believe show great promise for Peacekeeper and follow-on Small ICBM survivability in the future.

As a result of the 1986 Congressional authorization, which limited Peacekeeper deployment in existing silos to 50 missiles and specified that additional deployments, subject to Congressional approval, be in an alternate basing mode, we have expanded our advanced basing technology studies to include hardened Minuteman facilities concepts including ground and rail mobile, concealment concepts which include the shallow tunnel and the new carry hard concept. While renewed study of these efforts was initiated for follow-on Peacekeeper deployments, the work we are doing is equally applicable to follow-on SICBM deployments.



## ICBM ADVANCED BASING TECHNOLOGY STATUS

SILO HARDNESS DEMONSTRATED TO MANY TIMES EXISTING LEVELS

ICBM DEBRIS EGRESS SYSTEM TESTED

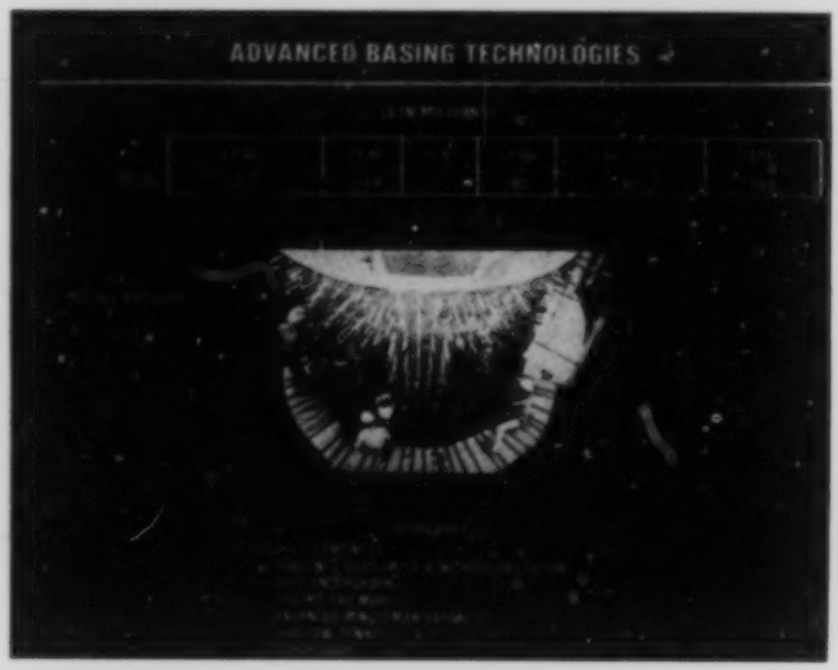
DELETED DELETED

DELETED DELETED

DEEP BASING VERTICAL EGRESS SYSTEM DEMONSTRATED

- CONTINUED STUDY ON ADVANCED BASING CONCEPTS
  - HARDENED MINUTEMAN
  - SUPER HARD SILOS
  - GROUND RAIL MOBILE
  - SHALLOW TUNNEL
  - CARRY HARD
  - DEEP UNDERGROUND
- APPLICABLE TO PEACEKEEPER OR FOLLOW ON SMALL ICBM

Our FY 87 advanced basing technology R&D request is $389M. These funds will be used to continue pre-full scale development on the most promising of the basing concepts which we are currently evaluating and to continue a low level of effort on the deep basing program.



## ADVANCED BASING TECHNOLOGIES

Funding will be used for both full and subscale testing in the area of concealment, mobility, hardening, launch control, blast and shock testing, and constructability evaluations in support of a potential full scale development decision to be made on one or more of these modes in FY 88.

## FY 87 ADVANCED BASING TECHNOLOGY RDT&E TASKS

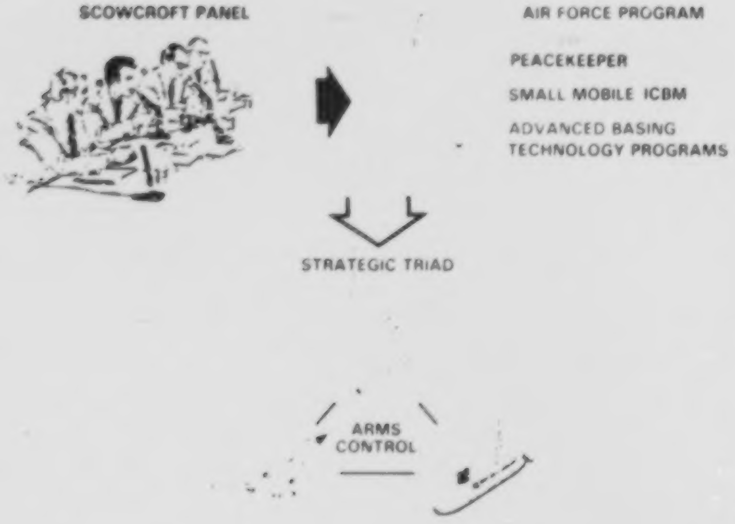
CONTINUE PRE FSD DEVELOPMENT ON MOST PROMISING BASING CONCEPTS

FULL AND SUBSCALE TESTING

| | |
|---|---|
| CONCEALMENT | LAUNCH CONTROL |
| MOBILITY | BLAST AND SHOCK |
| HARDENING | CONSTRUCTABILITY |

APPLICABLE TO PEACEKEEPER OR FOLLOW ON SMALL ICBM

## SUMMARY



SCOWCROFT PANEL

AIR FORCE PROGRAM

PEACEKEEPER

SMALL MOBILE ICBM

ADVANCED BASING TECHNOLOGY PROGRAMS

STRATEGIC TRIAD

ARMS CONTROL

In conclusion, our ICBM modernization program is progressing very well. The Peacekeeper program is on schedule and IOC is just ten months away. Great progress has been made on the SICBM and Hard Mobile Launcher and both programs are meeting all design requirements. The Air Force is preparing to enter full-scale development in FY 87 in order to meet the Congressionally mandated 1992 IOC for the SICBM. Our advanced basing technology programs have shown considerable promise in the area of silo hardening. By the end of this year, Peacekeeper will begin to redress the asymmetry in prompt hard target kill capability that currently exists between us and the Soviet Strategic Rocket Force. The highly survivable SICBM system will be available in the early part of the next decade because of the work we are doing today. With continued Congressional support, progress will be made in our advanced basing technologies which will significantly enhance the survivability and stability of our future ICBM systems and yield high levels of deterrence well into the next century.

Mr. HERTEL. Anything else from the members?

Thank you very much and all the people that participated in the presentation.

Dr. COOPER. Thank you, Mr. Chairman.

[Whereupon, at 4 p.m., the subcommittee was adjourned.]

# DEPARTMENT OF DEFENSE REQUEST FOR AUTHORIZATION FOR THE FISCAL YEAR 1987 COMMAND, CONTROL, COMMUNICATIONS AND INTELLIGENCE PROGRAM

House of Representatives,
Committee on Armed Services,
Research and Development Subcommittee,
*Washington, DC, Thursday, February 27, 1986.*

The subcommittee met, pursuant to call, at 10:10 a.m., in room 2212, Rayburn House Office Building, Hon. Melvin Price (chairman of the subcommittee) presiding.

Mr. Price. The subcommittee will come to order.

This morning the subcommittee will review the Department of Defense request for authorization for the fiscal year 1987 Command, Control, Communications and Intelligence Program.

The principal witness is Hon. Donald C. Latham, Assistant Secretary of Defense for Command, Control, Communications, and Intelligence. Mr. Latham will present the fiscal year 1987 program which amounts to $23 billion in the authorization request.

Mr. Secretary, you have been advised of the deficiency in your electronic warfare roadmap. This roadmap was required by the conference committee for the fiscal year 1986 RDT&E budget and quite honestly the roadmap submitted by the Department of Defense is not responsive to what we wanted. I would hope that you will be able to give us a status report on the submission of a long-range plan.

Mr. Secretary, we have a great deal to cover so you may begin.

## STATEMENT OF HON. DONALD C. LATHAM, ASSISTANT SECRETARY OF DEFENSE (COMMAND, CONTROL, COMMUNICATIONS, AND INTELLIGENCE)

Mr. Latham. Thank you, sir.

If I may, sir, I would like to ask that the hearing be a closed hearing as there is classified information in the briefing that I would like to share with you, sir. I believe we have checked everybody in the room and they are OK.

### Discussion Outline

A command, control, communications and intelligence ($C^3I$) assessment.
Trends—accomplishments—Soviet vis-a-vis U.S.
Major $C^3$ program initiatives.
The fiscal year 1987 budget request.
Some observations.

If I might, sir, Mr. Chairman, I would like to run over the information that I have summarized here. I would like to give you an assessment up front in where we think we are in this C³I area. Then I would like to share with you some of the major program initiatives, and address some of the concerns you have, especially that electronic warfare report, and then share with you the fiscal story and then provide some observations.

### COMMAND, CONTROL, COMMUNICATIONS AND INTELLIGENCE (C³I)

#### AN ASSESSMENT

C³I programs are fiscally well supported.
Significant programmatic progress is evident.
So far—only one major C³ program "in trouble."
Internal DOD oversight strengthened; single focal point for C³I.
Joint programs still difficult but workable.
Interoperability, commonality, and reliability being stressed.
Impact of shuttle loss being assessed.

First of all, I can say—and I will show you the numbers later—that you all have treated us very well in the C³I world both the command, control and communications and the intelligence world have been well supported as the top priority program and I really appreciate that.

Second, I am going to share with you, and I think we have made some significant programmatic progress. In other words, there has been a lot of money put in over the last 5 years. What is coming out of all of that and what can you expect in the future in both R&D and procurement.

Next, I can say that we do have at least one program in some trouble. Of all the money C³I programs, the one that I am most worried about is one that this committee has had a great deal of interest in, and concern about, and that is the Advanced Self-Protection Jammer Program, the ASPJ, and we will talk more about that later.

As you know, the Secretary reorganized the Office of the Secretary of Defense, and I am now the focal point for C³I including the policy aspects, space policy, communications security, computer security, and special operations forces.

We have a large number of joint programs in the C³I program area. About 65 percent of the programs are joint cross-service or allied. They are very difficult programs in general, but they are workable. I don't know of any magic solution for the execution of joint programs. Each one is almost a special case. They can be handled very differently, depending on what the program is, and who the lead service is, but so far so good in the C³I area.

We are stressing in the program these words here that you have heard a lot about, interoperability, reliability, commonality, and things of that nature. We are especially concerned in the area of reliability, interoperability and we are paying a great deal of attention to that. For example, the newest airborne jam-resistant VHF radio for the Air Force has a 4,000-hour mean time between failure [MTBF] specification requirement. This is up from a few hundred hours a few years ago when we were buying radios, and I think we can achieve that kind of a number for MTBF.

Lastly, one of the great concerns we have now is what happens as a result of the shuttle loss. If you care to go into that, I will be glad to discuss that with you. I have some material that I briefed Mr. Weinberger on last week as to the impact, as we see it at this point.

Mr. McCURDY. Is that specifically for DOD space systems?

Mr. LATHAM. I could give you an assessment on overall, because we have a lot of satellites on orbit. We are now going to be delayed quite a while depending on how long the STS is shut down.

You might ask the question where did the trillion dollars go. Let me share one slide of the programmatic progress in this area.

### EXAMPLES OF PROGRAMMATIC PROGRESS

Milstar in FSED and progressing well.
Gwen being deployed.
Two DSCS IIIs on orbit—Third launched in late 1986.
GPS in production.
MSE awarded.
Many TRITAC systems in production.
Upgrades to warning system progressing: DSP, BMEWS, North Warning; OTHB.
Fleetsats 6/7/8 in production.
PLSS nearing production go ahead.
Jstars underway.
42 EF-111s delivered.

We have the Milstar in full-scale development. The hardware is coming along for the first satellite. The system has played through a terminal. We brought the prototype terminal out from Raytheon, and the system actually play through the entire terminal. We will see I think the first launch in the [deleted] time frame as we are currently advertising, very capable program but one that gives us incredible capability over what we have today with the current DSCS satellites or the UHF fleetsat satellites. Much, much more jam-resistant, much more capacity, much more survivability, and things of that nature.

The ground wave emergency network (GWEN) which is the overlay, I call it to the U.S. telephone system. It is a low data rate, relatively inexpensive, packet-switched network operating at a low frequency. The DOD can use GWEN for emergency action messages and sending force direction messages out, all at low data rates. It is coming along well with the first 57 nodes to be in place by [deleted].

The global positioning system [GPS] satellites are in production under a fixed-price contracts for 28 satellites. The man-pack, the shipboard and the airborne terminals are starting to enter low rate production, and we are keeping it at a low rate until we can be absolutely assured that the reliability numbers we are shooting for are going to be reached. This is a program that is directly impacted severely by the shuttle loss, because the production GPS satellites were only designed to go on the shuttle. In order to get them up we are going to have to convert some GPS satellites to expendable launch vehicles [ELV's]. This is going to delay the achievement of the fully operational 18 satellite constellation by several months depending on how long the shuttle is shut down.

Mr. McCURDY. What is your forecast? Is there any way to project?

Mr. LATHAM. We have done a study saying let's look at a 6-month, 12, 18, and 24-month shutdown. My best guess is now, having talked to Mr. Graham personally and looked at a lot of reports and discussions with the Air Force and so on, that we are looking at least 12 months, and I would guess closer to 18 shutdown, so somewhere in that ballpark.

Mr. MCCURDY. That really impacts.

Mr. LATHAM. Yes, it does. But I can show you on some vugraphs specifically what things move to the right. Some of our programs are delayed day for day. For example, there was a [deleted]. That gets launched [deleted] if it is only a 12-month shutdown. Any more than that, it is a day-for-day slip. That is correct.

Mr. MCCURDY. Are you going to get to that later on in the briefing?

Mr. LATHAM. That is something I will have to come back to. I will be glad to do that.

Mr. BADHAM. What kind of a modification are you talking about on expendable launch vehicles?

Mr. LATHAM. What you do when you design a satellite, sir, is you qualify it for a given environment of vibration and shock and thermal, and importantly acoustics, and so that when that satellite is riding inside a shroud on an expendable launch vehicle versus riding inside the shuttle bay, it sees a different physical environment. You have to just insure yourself that the environment can be sustained by the satellite, no matter which vehicle it is riding on, and then second, you have got to make sure that the attachments, the mechanical attachments and launching mechanism that were designed for either way can be accommodated.

Now, in the case of GPS, we have got to go back and design a launching mechanism, because we can put more than one of those on expendable launch vehicle. We can get two or more on some ELV's and get them on-orbit. We have got some design and qualification work to do there.

Mr. MCCURDY. [Deleted] were redesigned specifically for the shuttle. They are too big, literally just too big for an expendable, and that really does put us in——

Mr. LATHAM. We are going to have to go back in the CELV Program that the Congress approved last year for 10 vehicles to accommodate some of these [deleted] as well, which could be done, but it is going to take 2 to 3 years to do that. I will come back and we can talk about that in more detail.

The Army has awarded the Mobile Subscriber Equipment [MSE] contract. That is a nondevelopmental program, as you know, $4.3 billion; to equip the Army including the Guard and Reserves with all new communications switching equipment at the tactical level. It is on track. We are asking for a little over $900 million in procurement money in 1987 for that program.

We have the TRITAC program, as you know. It has been around for many years, and it has essentially completed R&D. There is very little left, a few pieces here and there. It is in production in the large and moving along quite well—again several hundred million dollars there for procurement. Basically, the message that I gave Mr. Stratton's Subcommittee on Procurement the other day, if you look at the procurement bow wave, if I can call it that, for

C$^3$I systems there is a very heavy up-front cost in the late 1980's here. In other words, the 1987-88-89 timeframe we are buying now an enormous amount of equipment, and by 1990 this curve tips over. I predict that we will see a downtown in the C$^3$I programs on the procurement side in the 1990-92 timeframe.

We are upgrading the strategic warning systems. The BMEWS is being upgraded. The PAVE PAWS Radars are being increased from two to four. We have a new [deleted]. Again, that is another program that can be configured for dual launch either an expendable launch vehicle or the shuttle. Right now it is on an ELV. That launch may hold on time, but that is yet to be seen.

We are in production on three more FLTSAT UHF satellites, Nos. 6, 7, and 8. These will all be launched on expendable launch vehicles. [Deleted.]

Mr. McCurdy. Was there any delay caused by the one expendable launch that we lost in western——

Mr. Latham. On [deleted] capabilities?

Mr. McCurdy. Yes.

Mr. Latham. Yes, we had to shut down, as you know, the Titan 34D launches, until we could find out what happened. The Air Force does understand what happened on that accident but not necessarily the specific causes. There were multiple failures on that launch any one of which probably could have caused the thing to fail. The next launch is [deleted].

Mr. McCurdy. There hasn't been a loss since then?

Mr. Latham. No. We have had 6 months plus shutdown. You can imagine the shuttle shutdown. The Titan 34D is a much more simplified system on which to perform a launch failure analysis to make sure everything is OK and yet that required a 6-months shutdown. That is why I am saying there is no way and, by the way, there was no redesign, needed in the 34D case. It looks like there were just a series of factors and so on, so that is why it looks like if there is any redesign whatsoever of any component in the shuttle system, you can look to probably a year or better, and especially if you have to requalify the solid rocket motors.

Mr. Battista. On the OTH-B you are going to four now?

Mr. Latham. We will go to four by [deleting]. There will be one on the east coast, one west, one looking south and one in the central sector, to pick up the gaps that the east and west coasts have against cruise missiles.

Mr. Battista. Do we have programs for that now?

Mr. Latham. Yes.

Mr. Battista. One thing I wanted to ask is if the Soviets surprised us and deployed a [deleted] would the four systems give us adequate coverage?

Mr. Latham. We are at a frequency range that I think would have a good capability. I can show you some cross-sections data, but I think we are probably OK. We are going to make some live tests, as you know, starting in [deleted]. We are running tests now against the experimental radar out on the west coast, and [deleted] and there is not much you can do about some of that, at those [deleted].

Mr. McCurdy. How secure are the physical sites themselves?

Mr. LATHAM. [Deleted.] But again, they are way up in the boonies and animals and all that, and your false alarm problem, we have to look at that. I hope there just not very many people running around that do that.

When a war starts all bets are off.

Mr. McCURDY. Mr. Chairman, this is not an arbitrary question, because I was at an [deleted] and one of our most important [deleted].

Mr. LATHAM. Right.

Mr. McCURDY. A very, very important facility. And I swear there wasn't [deleted].

Mr. LATHAM. That is right.

Mr. McCURDY. And there were no Navy or Air Force personnel with weapons, and we had to authorize about $2 million in just fences and security.

Mr. LATHAM. For that.

Mr. McCURDY. I think throughout the entire spectrum of the [deleted] and communications sites as well.

Mr. LATHAM. It's a good point. What we have done—and fortunately we haven't had any real problem, but we have gone back now, and we have a program that the Corps of Engineers is responsible for, for the worldwide sites, and it is not just physical security. It is a comprehensive set of actions. You would be appalled, frankly, if you would have asked a couple of years ago if [deleted]. We didn't do anything until something really happened, but it is just now being fixed.

Mr. BATTISTA. Let me just disagree with you a little bit. I got a briefing last year from Jack Koehler. Do you remember General Koehler?

Mr. LATHAM. Yes.

Mr. BATTISTA. Jack lived in town here then, and he alerted me to a security system, a base security system, low cost, effective, low false alarm. They are selling them all over Europe, you can't get anybody in the Pentagon to look at them. For a [deleted] you know, for an investment of five figures, under six figures, you can come up with I think an adequate level of base security, at least in terms of an alarm system.

Mr. LATHAM. Why don't you tell him to come and see me. I haven't heard about one that cheap. I will be glad to talk to him, sure.

We are going to talk today about PLSS, the Position Location Strike System, and where it stands in terms of the test results, and I will share with you some very recent test data. The JSTARS, we are going to talk about that later. It is underway, as you know.

Mr. PRICE. We have heard that the Air Force wants to kill it—for example PLSS.

Mr. LATHAM. I am going to come back and talk to you about that, sir. Yes, sir, there is a move in that direction that I am working on, to put it mildly.

We have taken delivery of 42 EF-111s finally.

## INTEGRATED AIR/LAND COMBAT OPERATIONS

I thought it would be helpful in order to set the context of why do we want all these piece parts, why a PLLS, why JSTARS, how does it fit together with a secure voice, and what are the bad guys doing. I thought it would be helpful just briefly to look at what the bad guys are doing. Let me focus on the air operations and show you what the Soviets are up to. It is very, very impressive. This came up in the House Permanent Select Committee on Intelligence [HPSCI] yesterday, that every time you turn a rock over and you look in depth at what the Soviets are doing they surprise us technologically. [Deleted.]

### GOALS AND OBJECTIVES TACTICAL SYSTEMS AND INTEGRATED $C^3I$

Employ an integrated systems approach; Joint requirements; Tactics; Weapons/$C^3I$

Develop all-weather/nighttime engagement capability from standoff: ASEARS II; SIGINT; JSTARS; JTACMS.

Emphasize electronic combat and $C^3$: Lethal; nonlethal.

Survivability and endurance paramount.

Employ tactical deception.

Win I.

Everyplace I turn I find they are a lot better than people want to give them credit for. Not only technologically have they done a good job, but they put it together in a systems sense better than I think we thought they could. Let me show you.

First of all, how are we trying to approach this? We are saying you have really got to look at this as an integrated systems approach in terms of requirements, tactics, weapons and associated $C^3I$ that supports that. You have got to look at this as an all-weather nighttime mission. You can't just play a daytime situation plus these various sensor platforms and missile systems have all got to work together and especially from standoff. That has got to be part of it. I am going to come back to you and talk a lot about electronic combat, both lethal and nonlethal, because it plays a very important role in this area, especially on the airborne side of things.

Survivability has got to be stressed, and it is paramount in my mind. We are not doing enough in [deleted]. Lastly, you hope you would win if you did get into an engagement. [Deleted.]

What are the Soviets doing. This is a summary of where they are in their $C^3$ area for air warfare. They have done a beautiful job of what I call wiring up the battlefield [deleted] so they have used all kinds of sensors in an integrated way.

[Deleted.] Let me show you where they are going in fighters. If you look at the Soviet fighters in 1965, they played in the [deleted].

Now, if you look at the fighters in particular, here is the latest three fighters of the Soviets, Mig-31, SU-27, and Mig-29. I have summarized here for you some of the key characteristics. If you come down and you look at things like [deleted]. So the world is getting very dangerous; he is in high-rate production on the fighter today.

Now look at the F-16 and F-15, and you see that we have put our radars nicely into a narrow frequency band. [Deleted] in any of those radars, although the new [deleted]. That is a very sad story. I don't think we should be in that posture.

Look at this one as a comparison of the [deleted].

If you look at the threat summary then, he has got what we consider [deleted]. He has got an [deleted]. He has got it all wired up together pretty well.

I will give you an assessment which says most kills have and will continue to be made on unaware targets, and he has put in a fire control solution to help make that happen.

The future conflicts are going to be characterized by very advanced electronic systems and countermeasures, a very dense RF environment, multi-target engagements [deleted] all-environment weapons, extremely lethal out there.

### AERIAL WARFARE ASSESSMENT

[Deleted.]

Future conflicts will be characterized by: Advanced electronic systems and countermeasures; dense RF environment; multi-target engagements.

[Deleted.]

Extreme lethality.

U.S. and allies must counter a numerically superior threat that is approaching qualitative parity.

[Deleted.]

This numerically superior threat that is now approaching quantitative parity is a major challenge. We have [deleted] in order to keep up.

The conclusions then that one would reach on this—and by the way, this is a quick snapshot of a much more extensive study, and these vugraphs and what I am saying are in fact blessed by the Air Staff, so it is not just Don Latham saying this; we are going to have to have [deleted]. You are going to have to do something about exploitation and/or denial of his command and control systems, and you are going to have to turn the modern fighter into a [deleted].

He is going to have to be able to take on- and off-board sensor data and put it together in a rapid way to help him do the fire control solution and stay alive.

Mr. MCCURDY. Don, on that part there, ATF is what [deleted] down the road?

Mr. LATHAM. Yes.

Mr. MCCURDY. [Deleted]

Mr. LATHAM. Probably before you get very many of them, yes.

Mr. MCCURDY. That is right. And yet the Air Force is now talking about the F-15's and $1.8 billion a year for the next few years. You highlight the problems with the F-15's, communications and data links. Are we seriously thinking of going behind the thought of deep interdiction with a $40 million or $30 million aircraft that wasn't designed for that mission? Why don't we put the money where it should be, in something like an ATF, with the modern data packages that are going to make it survivable? I really question the logic in making that when you have got JSTARS and other things that can do a deep interdiction.

Mr. LATHAM. I guess the Air Force would be much more qualified than I am to answer that.

Mr. MCCURDY. I know what their answer is. I want an objective analysis.

Mr. LATHAM. Of course they look at the F-15E as having both an air-to-ground and an air-to-air role. Number two, this integrated avionics that I am talking about coming along for the ATF is unfortunately coming along at a place where it will nowheres match the F-15E kind of production or availability of that airframe with the engine and so on. The F-15E will have an improved onboard electronic countermeasure system [deleted].

Mr. McCurdy. What would the cross-section be on the F-15E?

Mr. Latham. Head on?

Mr. McCurdy. Yes, when we are talking about manned fighers now, they weren't designed for the job. I am just questioning priorities.

Mr. Latham. Yes, sir.

Mr. McCurdy. We have got to make decisions.

Mr. Latham. As you are well aware, I don't know whether more money would move the ATF along any faster, frankly. I doubt that it would, but we just started awfully late again.

Mr. Battista. Every year you come up here and you are very cohesive and give a cogent presentation on the threat. We know where you stand on the building. You are not exactly going to get the Man of the Year award from the Air Force or the Navy. You do it right. You try to do it right every year.

Now, Mr. McCurdy's point, for example. We are going to send a $40 million-a-copy fighter behind the lines there, even more importantly the crew, when in fact you know you have got on the drawing boards in conjunction with the activities in other parts of the Air Forces all kinds of good stuff that can do the job, and yet, like on the JSTARS, we know the experience you had yesterday over there. Here we are committing to a multi-megabuck program on the C-18.

Mr. Latham. I am going to get to that.

Mr. Battista. You know the program, and the case you keep making. Why does this thing have to be made? Have you ever gotten an answer?

### MAJOR C$^3$I PROGRAM INITIATIVES

Mr. Latham. Let me try. Let me show you some things here, and I am going to have to have to excuse some people when I get to certain vugraphs. Let me talk first about this area called electronic combat. Let me give you an assessment here. I say, and this is my perspective now, not the Air Force's or the Navy's because I am having a hard time selling this, frankly, that it really is a shared responsibility of the fighter aircraft between what I call onboard systems and external systems.

My point is that the world has become very complex, and thus the sensors that are "off-board" of an aircraft, that can support him, are going to have to be able to support him in near real time in order to keep him alive and tell where targets are so he doesn't have to have his radar on all the time, for example. So I say it is a shared responsibility between on-board and off-board on external sensors and command and control. You also have to view this mission as a mix of lethal and nonlethal approaches, and the nonlethal area has got a lot of possibilities that we really haven't exploited yet.

For example, that [deleted] to confuse and deceive it and do some things that he wouldn't like.

### A PERSPECTIVE ON ELECTRONIC COMBAT

A shared responsibility of on-board and external systems.
Mix of lethal and nonlethal capability.
Includes countermeasures to $C^3I$ systems, deception, exploitation, "jamming."
Must be jointly accomplished: In acquisition; in combat.
Applies to both strategic and tactical operations.
Successful EC is a win or lose issue.

My definition of electronic combat includes the items noted here, deception, exploitation and "jamming," jamming in a very sophisticated way, not just brute force power jamming. It has got to be done jointly. It has got to be done jointly from an operations perspective and the capability must be acquired jointly done. There is no sense in having something invented for the Navy and then again for the Air Force. It applies, I claim, to both "strategic" and "tactical" operations, and in point of fact I say that these distinctions are blurring. By that I mean that the tactical fighters of the world are going to face SA-5's, they are going to face SA-10's, they are going to face SA-12's. So the difference between a strategic or tactical mission is going to be large dependent on whether it is a high altitude mission or a low-altitude mission since the air defense and the fire control systems they are facing will be nearly identical technically and the operational difference primarily in the deployment geometries and densities. So the distinction between electronic combat for strategic and tactical missions I think is disappearing.

Finally, we are going to have to be successful in this electronic combat area as it is going to be the difference between winning and losing and not primarily how fast the fighter can accelerate or turn. In fact, there was an interesting study recently done by ASD in response to the Air Staff, on whether it makes sense to put more capability into the engine on the F-15 and F-16 or would it be better to do something else. And the result came out that it would be better to upgrade the avionics and fire control systems in those two aircraft than it would be to have a few more pounds of thrust and a few more tenths of G in a turn or whatever other aerodynamic performance improvements you could get via engine upgrades.

### ELECTRONIC COMBAT MODERNIZATION [1]

| Program | Cumulative quantities | | |
|---|---|---|---|
| | Numbers procured being procured | | President's budget fiscal year 1987-91 and prior |
| | FY 1980 and prior | FY 1986 and prior | |
| F-15: | | | |
| ALR-56C | 0 | | |
| ALQ-135 band 3 | 0 | | |
| ALQ-135 band 1, 5 | 0 | | |
| ALE-45 | 0 | | |
| F-16: | | | |
| ALR-56M/74 | 0 | | |
| ALQ-165 (ASPJ-Air Force) | 0 | | |
| ALE-40 | 0 | | |
| ALE-47 | 0 | | |

ELECTRONIC COMBAT MODERNIZATION [1]—Continued

| Program | Cumulative quantities | | |
|---|---|---|---|
| | Numbers procured being procured | | President's budget fiscal year 1987-91 and prior |
| | FY 1980 and prior | FY 1986 and prior | |
| F-111's | 0 | | |
| ALR-621 | 0 | | |
| ALQ-189 gr ALQ-165 | 0 | | |
| ALE-40 | | | |

[1] Figures deleted for security reasons.

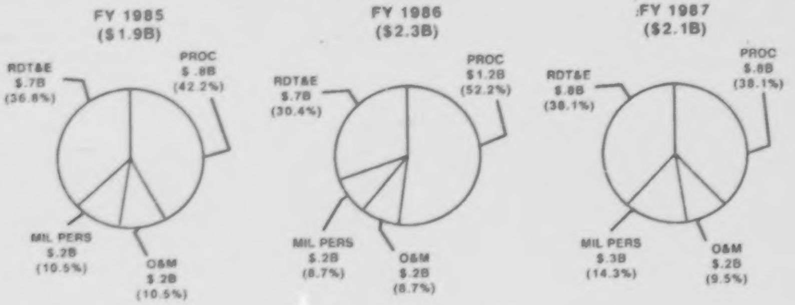
What have we bought in this electronic combat area? I have some vugraphs illustrating what we have accomplished. What did we have in 1980 and prior and what is being procured in fiscal year 1986 and prior numbers. This is hardware out at the end of the FYDP. Here we are with the F-15, F-16 and F-111's with the various equipments that they have onboard those aircraft, and you can see we started from a lot of zeroes and in 1986 and prior we will have those kinds of numbers shown here, and if we look out to the end FYDP we will have those kinds of numbers. As a result, there will be a very substantial amount of hardware deployed in those aircraft in the next few years from where we are today even. Is it the upgraded super deluxe integrated stuff we will have on the ATF? No; but it is very capable equipment and should be able to handle most of the threats to that point [deleted].

Continuing here, we are moving rapidly with other programs such as the EA-6B, radar warning receivers, various types of jammers, Air Force and Navy, and Army equipments and Compass Call communications jamming aircraft. That is what we have today coming into the force, and by 1991 here is what we will have. One of the messages you get from these two sets of vugraphs, by 1990-91, to make my point, I made earlier that we will be on a down curve in this procurement area because we will have bought out the force pretty much of these kinds of what I will call second or third generation equipment, so we should be able to see this procurement bulge coming down in that time frame.

Yes, the ATF and certain other programs will be taking off but the rapid growth in the $C^3$ procurement should level off.

**ELECTRONIC COMBAT RESOURCES BY APPROPRIATION**

**(TOA - $ IN BILLIONS)**

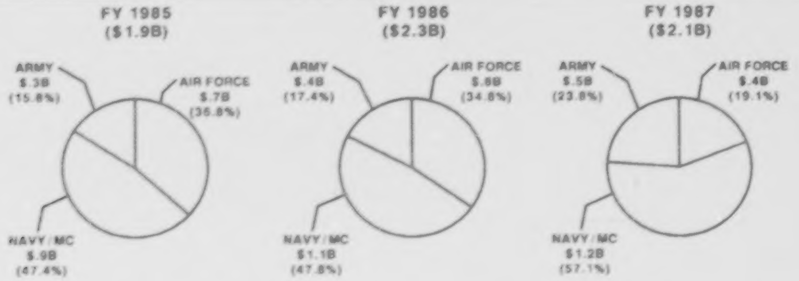


FEBRUARY 1986

If you look at the dollars in electronic combat, it is actually down in fiscal year 1987 from what we asked for in fiscal year 1986 by a few hundred million, and the reason is that aircraft procurement is down. The subsystems are going up and we are buying more black boxes, but we are buying less jamming aircraft.

**ELECTRONIC COMBAT RESOURCES BY DOD COMPONENT**

**(TOA - $ IN BILLIONS)**



FEBRUARY 1986

If you look at it by DOD component, the driving service is the Navy, because that includes ships as well as airborne EW equipment.

Let me talk about jamming for a second. This is an Air Force vugraph that is as a result of the Green Flag exercise of 2 years ago.

Notice what the title says, "Percentage of Non Effective Sorties." [Deleted.] The Air Force has stepped out very smartly in a program called Have Quick. Let me summarize where we are in the AJ area.

This says the following. If you want to fly a counter air mission or a defensive counter air mission or do suppression of enemy air defenses, that [deleted] percent of the time that they sent aircraft out to do that kind of a mission [deleted].

Mr. McCURDY. From ground jammers?

Mr. LATHAM. From ground and airborne jammers. What we have got is a combination of ground and airborne jammers that we are faced with the Soviet inventory in these frequency ranges.

Mr. McCURDY. Were those [deleted] ground systems?

Mr. LATHAM. These were [deleted].

### JAM RESISTANT SECURE COMMUNICATIONS

#### STATUS AND ISSUES

- Have Quick (HQ) extensively deployed by USAF.
- Other services and some allies also deploying HQ.
- Have Quick IIA in development: Fast hopper on more frequencies.
- TDMA JTIDS now common across all services.
- U.K. also employing TDMA JTIDS.
- U.S. urging NATO to adopt MIDS (TDMA JTIDS).
- Enhanced JTIDS (EJS) being terminated.
- ICNIA in development for mid-1990s.
- Issue: a credible, enduring roadmap for A/J COMMS.

What are we doing? We bought this Have Quick system and it is extensively deployed. We have several thousand deployed in USAF fighters. The U.S. Army, the Navy plus allies such as the British, Germans, and Italians are going to buy them so we will have a NATO-wide capable AJ system that is very cheap and capable. Today, we only pay about $7,000 a radio for Have Quick radio.

Despite what we are going, though, the Soviets have been busy. The [deleted] can be beaten however by a follower jammer in a one-on-one case. This has led us to build a better version, called Have Quick IIA. It [deleted]. We will retrofit the radios with that. The projection is all service buys by the end of the decade are about [deleted].

Mr. McCURDY. What does it do? Does it change frequency?

Mr. LATHAM. It changes frequencies across the UHF band from 225 to 400 MEL. It hops across that band at a high rate in random fashion.

Mr. McCURDY. It picks up a jam, it changes?

Mr. LATHAM. No, it doesn't detect any jammers. It just tries to stay ahead of somebody that might try to put a jammer on all the various channels we have.

Mr. McCURDY. Rotates?

Mr. LATHAM. It just rotates or hopes the radio a controlled cryptographic algorithm. What the Soviets have done is in response to our capabilities here, which have been widely publicized so they know what Have Quick is [deleted] following jammer, which is a more difficult technical thing to do, what they have done is they [deleted].

Let me now turn to the TDMA JTIDS program. We have as a result of the Navy cancellation of their DTMA Program which got into very serious technical difficulty and cost difficulty, everybody signed up for the Air Force TDMA Program. I can honestly report we have Navy officers at ESD, Army officers up there, and we truly have a joint effort underway now. Some of the details have yet to be worked out, I will be honest but it looks favorable for a cooperative joint JTIDS Program.

Mr. McCurdy. Is there a contract in development?

Mr. Latham. Yes.

Mr. McCurdy. Where are we?

Mr. Latham. The Air Force contract for JTIDS is ongoing, and the money in 1986 will start the preproduction effort on JTIDS. They have produced some several dozen sets. There are five F-15's with JTIDS in now. There are going to be like a dozen Army equipments, and they are going to conduct a test down at Eglin with JTIDS this summer. There will be an air-ground test with F-15's and so on. It will be very interesting. I am convinced, by the way, that once you get some of these people in the back seat and see what you can do with that, that there will be more people signing up for JTIDS.

The current approach is that the Navy will buy off the Air Force production for their JTIDS equipment requirements. They will have the Air Force contractor integrate them into their ships and they will have their Navy air frame contractors integrate them into naval aircraft.

We are also urging the rest of NATO to buy TDMA JTIDS called MIDS. We think other NATO allies are going to come onboard to coproduce JTIDS/MIDS in Europe.

The enhanced JTIDS program which the Air Force started——

Mr. Dickinson. Let me interject a question there. [Deleted.]

Mr. Battista. Sort of an inventive detail, for 2 years running I have been asking to get an STU-II phone in the committee offices.

Mr. Latham. You haven't gotten one yet?

Mr. Battista. No, and you have the NAS budget.

Mr. Latham. We have several thousand produced to date. I will get you one.

Mr. Battista. I wanted to ask one other thing. If I remember correctly, it was a quick, close look at the one book—is it $200 million for JTIDS this year?

Mr. Latham. I will have to get the chart. I don't remember what it is. We put the money all in an OSD account for 1987 again. You have got to be careful. There is money for integration of JTIDS in the ships and airplanes, and there is money for the group B box development, and I am not sure if there is a Navy line item for that or not.

Mr. Battista. Does the Army have this in the helicopter?

Mr. Latham. The Army has not decided yet whether to put JTIDS in helicopters. I don't believe they are going to do that. They are going to use their airborne SINCGARS radio which the Air Force will carry in the air and on the ground and they will also carry a PLRS hybrid JTIDS box, which allows them to communicate through that network so there is interoperability but not the JTIDS by itself.

Mr. **Battista.** Will you check the integration costs?

Mr. **Latham.** I will.

Mr. **Battista.** Because I will tell you they were asking for $147 million to integrate the DTDMA and that was just out of sight.

Mr. **Latham.** That is $147 million just to integrate JTIDS on the E-2C, one airplane, believe it or not.

Mr. **Battista.** How do you resolve the difference between the Air Force doing it for a fraction of that, and their request for these exorbitant costs?

Mr. **Latham.** If you ask the Air Force how much it is going to cost to integrate the class 2 JTIDS terminal with the so-called TADIL-J in the AWACS, you get a number that is in excess of $100 million also. You start going into what they are charging you for, and you find that there are major upgrades to the whole back end of the airplane, and those kind of get swept up under JTIDS integration, like new software for the system, a new computer on AWACS and the same thing on the E-2C. So it is not truly just the JTIDS boxes but there are a lot of other things.

The enhanced JTIDS [EJS] Program has been terminated or will be shortly. That was a program the Air Force initiated 2 years ago for a high-AJ voice system. However, with Have Quick II; [deleted] we can get the jam-resistant performance, it looks like, for a fraction of the cost.

The ICNIA, which is an acronym for a system that has multifunctions in it, communications, navigation, and so on, is in development with two teams working. This will be the communications-navigation—identification—integration system that will go in the advance tactical fighter and maybe into some F-15's and 16's. I need to get a credible roadmap done in this area which everybody can sign up to and is stable as we look in which we turn on something with great emotion and then have to turn it over again, and so on. I want to get everybody signed up for a roadmap in this area that we all agree to, including NATO. The NATO countries are also developing their versions of Have Quick II. We have to quickly get them onboard with us so we have a common wave form.

JOINT SURVEILLANCE AND TARGET ATTACK RADAR SYSTEM

[In millions of dollars]

| | Fiscal year 1986 | Fiscal year 1987 | Fiscal year 1988-91 |
|---|---|---|---|
| Funding:[1] | | | |
| RDT&E | | | |
| Procurement | | | |
| O&M | | | |
| MILCON | | | |
| Total | | | |
| Fiscal year 1987 program: | | | |
| Complete C-18 refurbishment; begin airworthiness flights | | | |
| Integrate communications system into C-18 | | | |
| Integrate surveillance and control data link ground terminals into ground station module | | | |
| Complete scale development of ground station module | | | |
| Test and integrate components of operations and control system into functional units | | | |
| Milestone IIB DSARC review | | | |
| Milestones:[1] | | | |
| FSED ground system (fiscal year 1984) | | | |
| DSARC II (fiscal year 1985) | | | |

JOINT SURVEILLANCE AND TARGET ATTACK RADAR SYSTEM—Continued

[In millions of dollars]

| | Fiscal year 1986 | Fiscal year 1987 | Fiscal year 1988-91 |
|---|---|---|---|
| Full scale dev contract (fiscal year 1985) | | | |
| Preliminary design review (fiscal year 1986) | | | |
| Critical design review (fiscal year 1987) | | | |

[1] Deleted for security reasons.

As you know, JSTARS is a concept in which an airborne radar, a very sophisticated airborne radar, would be used to [deleted] from the aircraft that has the radar onboard. It would perform that mission day, night, all weather, with this radar system. It would also have the capability of geopositioning those targets that it detected very accurately, to let's say [deleted]. That radar information can be downlinked to a ground processing center or it can be handled onboard a large aircraft like the C-18. The fire control decision could be made onboard the aircraft with both Army and Air Force crews, who would then either target an aircraft or a JTACMS kind of a missile, either Air Force or Army, onto that particular target, be it movers or guys that are sitting still. That is the concept.

Mr. DICKINSON. When you say downlink, do you get the same visual display on the ground?

Mr. LATHAM. Yes, sir.

Mr. DICKINSON. As you do in the air?

Mr. LATHAM. Yes, sir. The Army's ground station that they are building, and in fact have already got prototypes, will have radar displays that will show the same pictures as occurs on the scopes in the aircraft up above. Yes, sir.

Mr. PRICE. Mr. Battista.

Mr. BATTISTA. We are pretty familiar with the Joint STARS mission. Let's get to the heart of the issue.

Mr. LATHAM. I am going to.

Mr. BATTISTA. It was very contentious last year. We know what you have got up there.

Mr. LATHAM. That is the money you were asking about. Here is the breakout for the program and the Air Force number and the Army number for a total of $450 million. I am going to, if I can now, I wanted to get into the special access material because I think that is the heart of the matter. Could I get you all to leave for just a few minutes.

Mr. BATTISTA. While you are getting to that, this was a very contentious item last year. The conference report came out, asked for a report.

Mr. LATHAM. Yes.

Mr. BATTISTA. The Air Force went under contract 2 months before that report was sent to the Congress.

Mr. LATHAM. Yes.

Mr. BATTISTA. How do you explain that? That whole deck is stacked.

Mr. LATHAM. As I answered the same question yesterday, my answer would be no excuse, sir, really, because we shouldn't have done that. The only thing I can see is that since the report came out of OSD and Don Hicks was new and so on, somebody went ahead and let it happen.

Mr. BATTISTA. Wait a minute now, this is not Don Hicks' program. This is your program.

Mr. LATHAM. No, it isn't. It is a shared program. That is the problem. I don't control the JSTARS program. The P.E. for JSTARS is not in my office.

Mr. BATTISTA. The conference clearly took the money from the service and put it under OSD.

Mr. LATHAM. Yes.

Mr. BATTISTA. That is you.

Mr. LATHAM. No. Last year it went into an account that was a USDRE account. This year some of it is in an account which I control, and have oversight over, but in prior years it wasn't.

Mr. BATTISTA. I am told that the money is back in the Air Force this year.

Mr. LATHAM. The request is. I am going to show you that.

[Discussion off the record.]

### PLSS INTELLIGENCE AUGMENTATION SYSTEM [PIAS]

Mr. LATHAM. This is the Precision Location Strike System or PLSS. This program has been in development for a long number of years, $600-plus million of R&D has been expended on this program. What has been developed is a set of airborne avionics equipment and data links that are carried in a TR-1. The PLSS [deleted]. The program, in my judgment, has the potential to be a vital component or an integrated air-land combat system. The data links from the aircraft come down to the ground station where the data is processed and then handed into the Ground Attack Control Center (among other places) where the decision would be made to allocate weapons against those emitters.

Mr. McCURDY. Why could that not be a combination of JSTARS and this? Why are there two separate programs?

Mr. LATHAM. The PLSS system really must have at least two TR-1 aircraft and preferably three simultaneously on orbit in order to perform the geolocation function. If you had three JSTARS up, you could theoretically put this equipment on there—I say "theoretically"—could be put on the JSTARS platform and the PLSS mission done from that combined platform. However, the TR-1 provides the line of sight out to long ranges. You like the high altitudes, you like the TR-1's, for the PLSS mission. The PLSS emission equipment has been put into small packages so it can be carried on a small aircraft, so it is pretty much designed to the TR-1. In contrast, the C-18 is crammed full of backend scopes, computers and people plus the high power radar. It would be very difficult to combine the JSTARS and the PLSS mission in the same airframe—even a C-18.

Mr. McCURDY. What is that again?

Mr. LATHAM. It is a passive receiver, let me call it. As you will recall [deleted].

Mr. McCURDY. With the geolocation to the degree—what is the range you think?

Mr. LATHAM. From 60,000 feet, you are roughly "looking" out to about 300 miles.

Mr. McCURDY. I know, but I mean the targeted.

Mr. LATHAM. Yes.

Mr. McCURDY. So, clearly, a JTACMS interception would then be——

Mr. LATHAM. Easily.

Mr. McCURDY. Easily?

Mr. LATHAM. Yes.

Mr. McCURDY. And then you wouldn't have to turn on this transmitter until the very end?

Mr. LATHAM. You see, one of the things you can do with the PLSS is if an [deleted]. This means that you can update your ingoing missile, and attack I will say movable targets, not moving targets. There is currently a lot of controversy over the PLSS system, and all of a sudden just in the last 2 or 3 months there has been a groundswell of certain Air Force people saying, gee, I don't want this system anymore, or maybe I don't. And in fact there is a letter from the commander USAFE that recommends killing it. The test results are summarized here. Up to the 10th of February——

Mr. McCURDY. It would eliminate the need for pilots.

Mr. LATHAM. What we have got now is over 20 hours of collection time and on an average of 3 hours of collection, you are getting something like [deleted] geolocations. That is in a relatively benign environment. This is a test program out in the Western part of the United States. In the Central European areas where we have got lots more emitters, you would get even more intercepts. Let me show you the situation from last October until now, with both the two-aircraft and the three-aircraft case. We are up to [deleted] total locations computed. The collection time is on an exponential curve and the system is starting to work. The problem we had back in the October–November timeframe were both avionics and aircraft, getting everything to go has been a problem. They have now got that smoothed out and the thing is working quite well.

The AFSARC specs in terms of location accuracy, for example, probability of location, we are getting there, very, very good data so far. I claim that we will eventually get the PLSS system to not only meet spec but in many cases exceed it. It will meet the reliability number and so on.

Mr. McCURDY. Would Have Quick emitters on the ground have anything to do with that?

Mr. LATHAM. No.

Mr. McCURDY. Is there any way you can jam it or confuse?

Mr. LATHAM. You could certainly put a [deleted].

The bottom line is that we are in an early flight test program, an R&D program, and we are not quite all there yet, and we haven't gone through DT&E or OT&E. It is beginning to look like it is a good system and will work. The Air Force is finding that the cost to buy the avionics hardware to outfit what they thought would be the force structure is more than they want to pay, so they see this system as a financial issue.

Mr. McCURDY. What are you talking about here in cost?

Mr. LATHAM. For about nine shipsets it is between $300 and $400 million for support equipment and so on, and that is probably not enough for the force structure, and the Air Force only has about $300 million, roughly, in FYDP to buy this equipment out. What they are facing is a several hundred million dollars additional cost to buy PLSS out at an adequate size force structure.

In fact, the dollars are shown here.

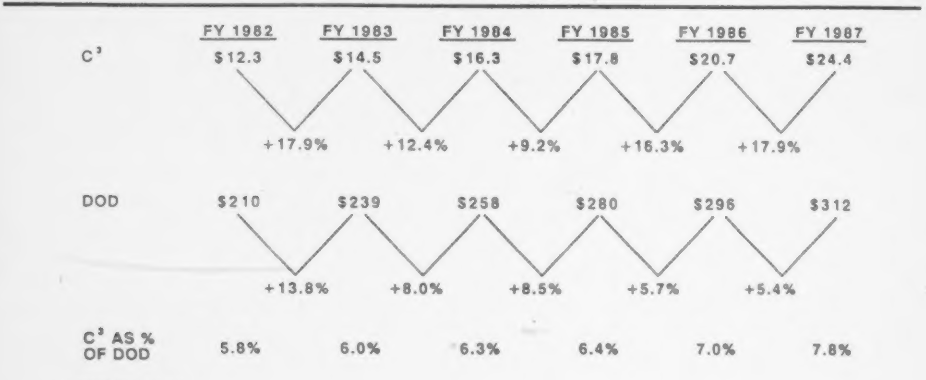
### C$^3$I PROGRAMS EXEMPT FROM FY 1986 GRAMM-RUDMAN REDUCTIONS

E-6A RDT&E.
EA-6B RDT&E.
MSE.
VH-60.
Circuit Mayflower.
Navstar GPS (multiyear).
DSCS (multiyear).
NDS (multiyear).

Let me just show you very quickly the dollar story. When Gramm-Rudman was exercised in 1986—you remember we had the flexibility that we did not have to take Gramm-Rudman reductions against all programs, we decided to protect the programs shown here. Most of these are multiyear contracts that were protected in 1986. In 1987 if the Gramm-Rudman deficit bill hits, no programs are exempt, no programs are protected. In the defense agencies, because of the way Gramm-Rudman and the fiscal year 1986 RDT&E allocated hit was taken and SDI protected, the RDT&E in the defense agencies was impacted as much as 20 to 27 percent, so some of these programs have taken significant hits if they are in defense agencies.

THE TALE OF THE TOA

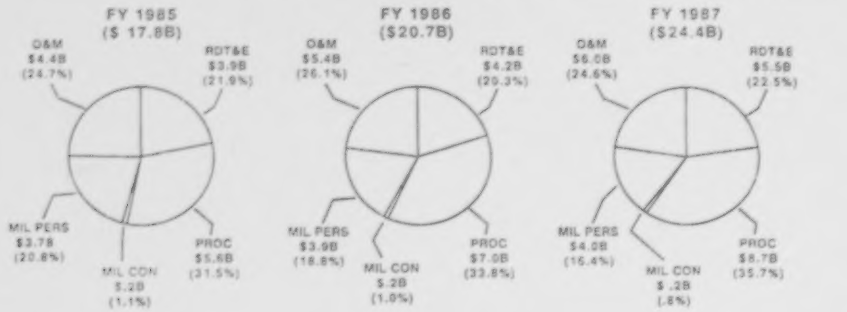
(TOA - $ IN BILLIONS)



MARCH 1986

You asked about how well have we done in command, control, and communications (C$^3$) fiscal growth. On this chart, I have plotted up at the top the communications appropriated number by fiscal years 1982 through 1987, then the DOD line, then the percentage increase each year. You see we have been treated quite well in the command, control, and communications area. As I showed you earlier, a lot of hardware is starting to roll out now as a result of this generous funding profile.

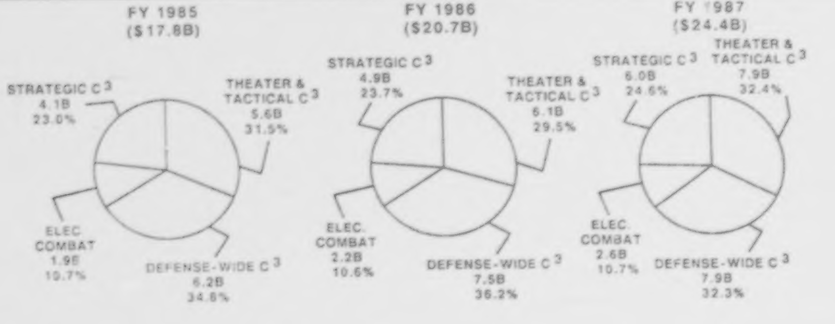
C$^3$ RESOURCES
BY APPROPRIATION
(TOA - $ IN BILLIONS)



MARCH 1986

There is about $8.7 billion in the 1987 budget just for procurement of C$^3$ equipment and a total of $24.4 billion up from a 1986 number of $20.7 billion.

C$^3$ RESOURCES
BY MISSION AREA
(TOA - $ IN BILLIONS)

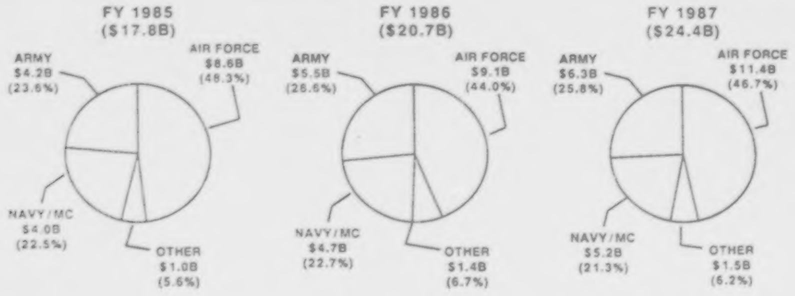


MARCH 1986

In terms of the mission areas, strategic, about 25 percent, theater and tactical about low 30's and so on, as noted here. So not too much change in the allocation from fiscal year 1986 to fiscal year

1987. And remember in the strategic side all the communications satellites are in there, so MILSTAR is a very big piece of that, for example.

**$C^3$ RESOURCES**
**BY DOD COMPONENT**
(TOA - $ IN BILLIONS)



MARCH 1986

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By DOD component, the Air Force dominates the command, control, and communications satellites, they have all the warning systems, things like that.

WHERE ARE WE GOING FROM HERE? $C^3$RDT&E

[In millions of dollars]

| | Fiscal year 1987 | Fiscal year's 1988–91[1] |
|---|---|---|
| Strategic $C^3$: | | |
| [Deleted] | | |
| [Deleted] | | |
| [Deleted] | | |
| E–6A | 81.7 | |
| DSCS | 14.0 | |
| Theater and Tactical $C^3$: | | |
| JTIDS | 221.7 | |
| AWACS | 137.2 | |
| JINTACCS | 81.7 | |
| JTC$^3$A | 77.7 | |
| CIS | 47.0 | |
| TRI–TAC | 45.4 | |
| HF/AJ | 34.5 | |
| SHORAD $C^2$ | 82.1 | |
| E–2C | 34.5 | |

[1] Figures deleted for security reasons.

Where are we going from here? What are you faced with as an R&D committee if I look out over several years for communications, command and control? I have summarized some here. You see programs such as MILSTAR dominate the RDT&E account, various theater tactical systems are quite sizable, but in most cases

I will tell you that these things play out over this FYDP and are completed. Most of these end up being through R&D.

WHERE ARE WE GOING FROM HERE? C$^3$RDT&E

[In millions of dollars]

| | Fiscal year 1987 | Fiscal years 1988-91[1] |
|---|---|---|
| Electronic combat: | | |
| ASPJ | $30.0 | |
| Compass call | 25.1 | |
| EA-6B | 69.7 | |
| Army ASE program | 25.1 | |
| SLQ-17/32 | 17.4 | |
| Defense-Wide C$^3$: | | |
| [Deleted] | | |
| [Deleted] | | |
| Granite sentry | 20.4 | |
| I-S/A AMPE | 54.6 | |
| WIS | 170.9 | |
| CCPDS-R | 27.4 | |
| Long-haul Comm (DCS) | 47.4 | |
| NAVSTAR GPS | 202.0 | |
| NCMC | 74.2 | |

[1] Deleted for security reasons

If we look at electronic combat again, some fairly sizable R&D numbers still, and in the computer security area, COMSEC area, continuing large expenditures, and WIS is the Worldwide Military Command and Control System, Improvement System, that is the WIS Program, that modernizes all the worldwide sites, some two dozen sites.

### Some Observations

Prior R&D "paying off" in procurement of C$^3$ system: Milstar; MRT; DSP; SINCGARS; ELF.
Major capabilities coming on-line: DSCS III; GPS; GWEN; COMSEC.
Increased procurement account growth in this decade.
Evolutionary acquisition—"a way of life".
Expect more NDI acquisitions—ALA MSE.

Just to summarize with some observations, I think we are seeing the R&D payoff, a lot of procurement, MILSTAR and so on, very major capabilities coming on line. I see some increase in the procurement account over this decade, because we have got the R&D over with.

Evolutionary acquisition, I think that is just a way of life. I hope and I believe that more MSE-type acquisitions can be made, that is without a lot of up-front moneys. Using NDI as an approach I see much more use of commercial developed equipment and software.

Lastly, like Lee Iacocca I am pleading to have you give me your tired, your poor, and your support for my budget.

Thank you.

Mr. McCurdy. Do you feel as embattled as Lee Iacocca?

Mr. Latham. I found that Vu-Graph in my desk. I used it years ago once when I was in industry to plead my case for something, I forgot what, and I figured it was still good to use.

[Mr. Latham's statement follows:]

## PREPARED STATEMENT OF HON. DONALD C. LATHAM

### I. INTRODUCTION

Mr. Chairman and Members of the Committee, it is again a privilege to appear before you to present the Department of Defense's (DoD) request for research and development (R&D) funding for Command, Control, and Communications, or $C^3$.

Several years ago when I first appeared before this subcommittee, my presentation focused on the substantial deficiencies which existed in the capabilities of our $C^3$ systems and our plans for correcting these deficiencies. Many of the principal initiatives for resolving these deficiencies and, in turn, improving the capabilities and survivability of our $C^3$ systems were embodied in the President's Strategic Modernization Program. In response to this appeal, Congress demonstrated their support by providing the funding necessary to begin the modernization of our $C^3$ systems. Since that time, the ability of our $C^3$ systems to support our forces and weapons systems has significantly increased as a result of this investment of fiscal resources and the intensified management of programs. Tangible improvements have been realized not only in our strategic $C^3$ systems, but also in our theater and tactical, electronic combat and defense-wide $C^3$ systems. We intend to continue following this course of eliminating identified weaknesses and continue the R&D activities necessary to take maximum advantage of opportunities. At the same time, this period of increasing fiscal austerity places further emphasis on attaining the most effective allocation of limited resources to ensure maximum leverage from our R&D efforts.

Today, my presentation covers not only the substantial progress we have made in improving our current $C^3$ systems, but also the strategy and the associated R&D activities necessary to develop future $C^3$ systems. Although I will not be discussing intelligence programs today, the information and capabilities provided by them are essential elements in achieving an effective $C^3$ capability. I assure you that we place an equal priority on our intelligence programs and view them as an important part of an integrated $C^3I$ systems package needed to effectively support all of our forces and the National Command Authorities (NCA).

### II. $C^3$ STRATEGY AND GOALS

Our strategy of deterrence of war through the defensive use of military power requires our military forces to react quickly if an enemy takes the first initiative. This commitment places a heavy reliance on $C^3$ systems that are capable of rapid and effective force management. To be successful, $C^3$ systems must provide the means to quickly transform individual, widely dispersed units into an integrated, effective force. These systems must satisfy the needs of all echelons of the forces to observe, provide warning, assess adversary intentions, collect and process information on the status of our won and hostile forces, support decision making, and communicate decisions to the forces.

In view of this strategy and corresponding requirements, our $C^3$ programs are guided by and directed at fulfilling the following goals:

(1) The capabilities and survivability of $C^3$ and associated systems must match those of the forces they support.

(2) Development and acquisition of $C^3$ capabilities [must have the same priority as the weapons and other systems they support.

(3) $C^3$ systems must have the connectivity, survivability, security, and interoperability necessary for effective joint and combined operations.

(4) Reliable, secure, and survivable $C^3$ must be maintained between the NCA, Joint Chiefs of Staff (JCS), nuclear Commander-in-Chiefs (CINC's) and strategic forces.

(5) $C^3$ systems must be secured by such means as necessary to prevent the compromise or exploitation of classified information.

(6) We must have a balanced $C^3$ countermeasures ($C^3CM$) capability to degrade enemy $C^3$ and protect our own $C^3$ from enemy countermeasures.

### III. $C^3$ RESOURCE SUMMARY

Our $C^3$ budget request for FY 1987 provides the resources necessary to fulfill these goals and reflects our plans for attaining these goals. To help us achieve a better overview and integration of the various $C^3$ systems and the forces they support, $C^3$ resources are managed within a mission area structure. Each mission area consists of a group of programs and associated resources mutually dedicated to addressing specific $C^3$ objectives. For FY 1987, the budget request for $C^3$ programs is approximately $24.4 billion, of which $5.5 billion is for research, development, test, and evaluation (RDT&E). The following three charts portray the overall resources for $C^3$ aggregated by: (1) appropriation, (2) DoD component, and (3) mission area for FY's 1985, 1986, and 1987. In addition, two $C^3$ RDT&E overview charts by DoD component and mission area, and a table displaying funding for major $C^3$ RDT&E programs are appended at the end of this statement.

### IV. $C^3$ MISSION AREA OVERVIEWS

Strategic, Theater and Tactical, Electronic Combat, and Defense-Wide are the major $C^3$ mission areas. The following mission area overviews highlight their objectives and summarize the status of key programs in each of these areas.

a. Strategic $C^3$.

This past summer, in a [deleted] the president [deleted] reaffirmed strategic $C^3$ as the uppermost priority in the Strategic Forces Modernization Program. The results of our R&D efforts, some of which were initiated as a part of the modernization program, are now paying off with $C^3$ hardware and systems being deployed. We are continuing to aggressively pursue R&D activities aimed at resolving those deficiencies which remain in the attack warning/attack assessment (AS/AA), command decision making, and communications connectivity capabilities of our strategic $C^3$ systems.

The programs in the first area, AW/AA, are subdivided into those directed at the ballistic missile threat and those associated with the atmospheric threat.

To support improved ballistic missile surveillance and warning, the PAVE PAWS expansion program is deploying two new phased array radars, one in the Southeast at Robins Air Force Base (AFB), Georgia, and one in the Southwest near Goodfellow AFB, Texas. These new sites will complement the two sites now in operation in the Northeast at Otis AFB, Massachusetts, and the Northwest at Beale AFB, California. Together with the Perimeter Acquisition Radar Attack Characterization System (PARCS) in North Dakota, they will comprise the planned CONUS-based five-site phased array warning network. The two new PAVE PAWS sites will initially be deployed in a configuration [deleted] deployment will close the gaps in warning coverage to the Southeast and Southwest. They will provide a significant improvement in attack warning capability, and will permit closing of the [deleted] the AN/FPS-85 radar site at Eglin AFB, Florida.

The Ballistic Missile Early Warning System (BMEWS) modernization program will assure continued, reliable warning of intercontinental ballistic missiles (ICBM's) by upgrading the system with new radars and upgrading data processing equipment at Thule, Greenland, and Fylingdales, United Kingdom. Upgrades to the Thule site are continuing, and the site is expected to reach Initial Operational Capability (IOC) in FY 1987. Replacement of the existing obsolete radar system at the Fylingdales site with a new phased-array system is scheduled to begin in FY 1986, with a projected IOC of FY [deleted]. These upgrades will significantly enhance the quality and detail of missile warning and attack assessment information available for decision making in the event of an attack by ICBM's and submarine launched ballistic missiles (SLBM's).

[Deleted.]

In the second area, atmospheric threat surveillance, the existing Distant Early Warning (DEW) Line is being totally replaced. This replacement, called the North Warning System (NWS), will result in a substantially improved capability to detect advanced aircraft and cruise missiles across the entire North American boundary. The new system will include 13 long range radars (LRR's) and approximately 39 unmanned short range radars (SRR's). The LRR's, which are proven equipment (FPS-117 radars) and already deployed in Alaska, will be installed and operating in [deleted]. The SRR's, which will operate unattended, are now under development and will be deployed in the [deleted]. The LRR's, which are designed for minimal manning, and the unattended SRR's will require substantially less manpower for their operation and, as a result, operational costs will be considerably reduced. Since the NWS will be acquired and operated jointly with Canada, the costs of the new system will be shared with Canada. An agreement reflecting this joint endeavor was signed in March 1985. The system is scheduled to attain Full Operational Capability (FOC) in [deleted].

The DEW Line upgrade, together with the new Over-the-Horizon Backscatter (OTH-B) radars planned for the east, west, central, and southern U.S., will provide complete contiguous surveillance coverage of all airbreathing threats to North America and assure timely warning of bomber or cruise missile attacks on North America. The OTH-B radars will provide all-altitude coverage for bomber aircraft from (deleted) out to 1800 nautical miles, [deleted] The first sector of the OTH-B East Coast system will be completed in [deleted] and integrated with the remaining two sectors in [deleted] to form a complete 180-degree coverage East Coast system. With acquisition beginning in [deleted] the remainder of the West Coast OTH-B system will be procured in [deleted]. The FY 1987 RDT&E funding will support several key functions including Development Test and Evaluation (DT&E) of the integrated East Coast system and cruise missile detection testing.

In the command decision making area, we are continuing to upgrade the survivability and capability of command centers that would direct U.S. strategic forces during periods of crises through nuclear conflict. During FY 1987, concept development of a $C^3$ suite for a next generation Airborne Command Post will continue and candidate replacement aircraft for the Worldwide Airborne Command Post (WWABNCP) system will be evaluated. Emphasis will continue to be placed on reducing the vulnerability of our airborne command posts to electromagnetic pulse (EMP) effects. Similarly, there is a continuing program to upgrade our EMP protection and electrical power capability at the National Military Command Center (NMCC) and other critical command facilities.

A recently initiated program, replacement of the Air Force One Presidential aircraft, will fulfill a much needed requirement for a new Presidential transport aircraft, as well as provide improved communications capabilities. For some time, we have recognized the deficiencies of the current Air Force One aircraft. The increasing information requirements of the President for both personal support and communications have outstripped the ability of the current type aircraft to provide sufficient support. Additional aircraft deficiencies include range, logistics supportability, takeoff and landing requirements, and Federal Aviation Administration imposed engine noise restrictions. Cost estimates have been developed for a replacement aircraft which would satisfy the transportation requirements of the President under any routine or foreseeable emergency situation. We anticipate that competition between qualified American wide-bodied aircraft manufacturers will produce the best product for the lowest price, and we are aggressively pursuing this development and acquisition strategy. A request for proposals to industry has been released, and the bidders' proposals are expected during early calendar year 1986.

These and other R&D efforts will help to ensure the survivability and effectiveness of our command facilities and, in turn, support their central role in the operation and control of strategic forces.

Our strategic communications programs are structured to provide improved communications and assured connectivity between sensor sites, command locations, and nuclear capable forces. In the ground-based, airborne relay, and satellite communications areas, we are making improvements in our strategic programs, with particular attention being focused on increased capacity, survivability, and endurance.

We are continuing to implement the ground-based communications improvements identified in the Strategic Forces Modernization Program. A major effort under the modernization program is the Ground Wave Emergency Network (GWEN), a dispersed network of radio relay stations and user terminals designed to provide assured communications connectivity to CONUS-based forces. This system will operate at low frequency and connect major command locations, sensor sites, strategic bomber bases, missile launch control centers, and strategic defense sites. The system will have sufficient relay node proliferation to provide high assurance of EMP-protected austere backbond communications connectivity for missile warning and emergency action message (EAM) dissemination. By the end of FY 1986 development of the prototype 57 relay station Thin Line Connectivity Capability (TLCC) will be completed and, following testing, the system will attain IOC. Prototyping of missile and airborne terminals and development of portable terminals will begin during FY 1987. Additional relay nodes and user terminals will be added to achieve a highly proliferated and survivable system, with a FOC planned for FY 1992.

Communications connectivity with our submarine forces is also being improved, and an associated reduction in their susceptibility to detection is being realized with the implementation of the Extremely Low Frequency (ELF) communications system. At the present, a submerged submarine must have an antenna at or near the surface of the water in order to obtain communications. By allowing continuous contact with submarines at much greater depths and at operating speeds, the ELF system will permit submarines to maneuver at near optimum depths and speeds, thereby reducing the possibility of detection and minimizing operational limitations. When completed, the system will have two transmitter sites. One is under construction in Michigan, near K.I. Sawyer AFB. The other site, already in existence, is near Clam Lake, Wisconsin. R&D funding requested for FY 1987 will allow the completion and certification of the Michigan Transmitter Facility, and support test and evaluation efforts leading to FOC of the system in FY 1988.

The Fleet Ballistic Missile (FBM) submarine force is the most survivable leg of the strategic triad. The deployment of the Trident weapon system has greatly expanded FBM communications coverage requirements which directly impact the TACAMO operation. As the replacement TACAMO aircraft, the E-6A, with greater range, speed, and endurance, will address these requirements. It will replace the aging EC-130 aircraft to significantly enhance the survivability, endurance, and performance of the vital TACAMO mission. We are currently fabricating the prototype E-6A aircraft and will begin ground, laboratory, and contractor flight testing in FY 1987.

In light of the critical role the FBM submarine force fulfills in strengthening our deterrence posture, it is essential that we develop and deploy redundant means to assure survivable and enduring communications to and from the strategic submarine force. Accordingly, the Navy is currently pursuing a technology program with the Defense Advanced Research Projects Agency (DARPA) for the potential development of a satellite-to-submarine blue laser communications system under the Satellite Laser Communications project. This potential future system would address the longer-term needs of employing another communications media for [deleted] the strategic submarine force and support improved tactical submarine communications. The FY 1987 budget request provides for the technology efforts and development of concepts necessary to permit a decision on whether to proceed with such a system by the end of [deleted]. The overriding issues will be cost, system survivability and endurance, and technical performance.

With the as yet unquantified delays in the Space Shuttle launch schedule resulting from the recent Challenger loss, there is a high likelihood for slippage in the launch schedules of some of our satellite communications (SATCOM) programs and other space-based systems. We are continuing to make improvements in the quality and cost effectiveness of our SATCOM programs. [Deleted.]

For the Defense Satellite Communications System (DSCS), [deleted]. In order to achieve cost savings, we have in place a firm fixed price multi-year procurement program for the acquisition of the remaining [deleted] satellites. [Deleted.]

b. Theater and Tactical $C^3$.

Theater and Tactical $C^3$ systems are essential to military commanders for planning directing, controlling and operating their forces, including nuclear capable forces. These systems play a vital role in the implementation of national strategy and employment of weapons through the spectrum of potential conflicts.

The overall objective of the theater and tactical $C^3$ program is to provide the secure, reliable and enduring $C^3$ systems needed to enable U.S. and allied forces to be used with maximum effectiveness on the tactical battlefield. Specifically, we seek to provide the theater and tactical forces with: secure, jam resistant, and interoperable voice and data communications capabilities; improved, interoperable identification systems; and a precise, worldwide, all weather, and jam resistant navigation capability. Our efforts are focused not only on individual service systems, but also address joint Service and combined U.S./allied capabilities.

In pursuit of these goals, we are continuing to implement a number of ongoing programs to improve our near-term $C^3$ capabilities and perform the R&D necessary to meet the theater and tactical $C^3$ needs of the future. These programs address: modernized communications and data distribution; needed upgrades of $C^3$ for the theater nuclear forces; automation of tactical air command and control systems; improved $C^3$ for contingency and crisis operations in areas where U.S. forces are not regularly deployed; improved identification capabilities to realize the combat potential of beyond-visual-range weapons; $C^3$ interoperability among and between U.S. and NATO $C^2$ systems; and improved management of air defense assets.

Effective data distribution is a key aspect of our theater and tactical $C^3$ architecture. To provide for reliable and survivable data communications, the Joint Tactical Information Distribution System (JTIDS) is being developed to provide a high capacity, secure, jam resistant, digital information exchange system for a wide variety of tactical forces. JTIDS capabilities include data and voice communications, position location/navigation and cooperative identification among systems users. In the FY 1986 Defense Authorization bill, Congress directed the DoD, in effect, to consolidate the Air Force and Navy JTIDS development programs. The Navy JTIDS development contract has been terminated because of programmatic difficulties and a joint program plan, schedule, and funding profile have been developed for the acquisition of the Air Force terminals by all of the Services. The FY 1987 RDT&E budget request for JTIDS supports the new plan. We intend to ensure that all JTIDS terminal R&D efforts are consolidated under a single JTIDS joint program office. The work required to integrate JTIDS terminals into the different aircraft, ground facilities and ships will be performed by the individual Services.

We are in production with the Position Location Reporting System (PLRS), a joint program that will provide combat commanders with automatic, near real-time identification and location of their forces on the battlefield. The capabilities are being expanded with the development of the Army Data Distribution System (ADDS). The ADDS, also known as the PLRS/JTIDS Hybrid (PJH), integrates the capabilities of these systems and will provide automatic tactical data distribution and an automatic capability for navigation, identification and reporting. The system is secure and jam resistant, and will provide near real-time communications and automatic relay of data messages regardless of weather, terrain or geographic location. Capitalizing on the preceding development efforts of the PLRS and JTIDS will make it possible to satisfy these essential battlefield data distribution requirements much earlier than would otherwise be possible. The budget request for 1987 will continue development and allow Developmental Test/Operational Test (DT/OT) II of the ADDS.

Existing high frequency (HF) systems are comprised of outdated equipment which provide neither anti-jam protection nor electromagnetic pulse protection, and require increasingly expensive logistics support. In order to alleviate these deficiencies, the HF Anti-Jam program is developing anti-jam (AJ) communications capabilities to meet voice, data, and radio teletype requirements. The program will develop and acquire an HF AJ communications system for the tactical battle group, tactical support [deleted]. The FY 1987 request will continue full scale engineering development of the HF AJ system.

The Integrated Electronic Warfare System (INEWS)/Integrated Communication Navigation Identification Avionics (ICNIA) effort focuses on totally integrating the avionics and electronic combat functions on new aircraft, and possibly on inventory aircraft as well. Total integration means the use of common hardware and software to implement the myriad of functions currently performed by black boxes. In the FY 1986 Defense Authorization Bill, the Congress consolidated the funding for what had previously been separate programs into a single INEWS/ICNIA program. The funding request for FY 1987 will continue this effort as a single, integrated program under the Air Force. The program will explore the benefits of technological advances that will result in size, weight, and power demand reductions in order to attack the problem and resulting expenses of integrating multiple black boxes into various platforms.

The Joint Tactical Command, Control, and Communications Agency (JTC$^3$A) was formed in 1984 by consolidating existing organizations. Its mission is to ensure the interoperability of tactical C$^3$ systems for joint or combined operations through the development and maintenance of a joint architecture, interface standards, and interface definitions for tactical systems.

The interoperability efforts of the JTC$^3$A have focused on achieving early user capability and immediate assistance to the commanders of the Unified and Specified Commands. Since its establishment, the agency has been actively working with the CINC's to identify near-term solutions to several C$^3$ problems. Additionally, it has begun developing the long-term tactical C$^3$ architectures that will become the road maps for evolving C$^3$ systems. Though we cannot expect immediate solutions to all the existing challenges of such complex issues, we are beginning to see increasingly significant contributions to tactical C$^3$ interoperability as a result of the efforts of the JTC$^3$A.

The JTC$^3$A is also responsible for managing the ongoing joint Interoperability of Tactical Command and Control Systems (JINTACCS) program, established to develop common message standards and procedures for critical command and control functional areas. JINTACCS is a joint interoperability program to improve the operational effectiveness of Service tactical C$^2$ systems in support of joint operations. For FY 1987, the JINTACCS program will continue development efforts for Tactical Digital Information Links (TADILs) and computer-to-computer communications, including configuration management testing, and support for allied efforts on message text format (MTF) messages in the tactical functional areas. Funding for the JINTACCS program supports the comprehensive testing and integration of approximately 30 tactical C$^2$ systems to insure that automated tactical command and control systems achieve and maintain interoperability. This includes a major software configuration management effort.

Our program to improve the combat identification capabilities of our forces is also making substantial progress. After years of debate, basic agreement on the design of a new cooperative identification system was reached between the U.S. and Germany, which cleared the way for a NATO-wide agreement. This system, designated Mark XV in the U.S., will supplement the aging Mark XII system, and will be developed in collaboration with our NATO allies as part of the NATO Identification System. The budget request for FY 1987 will support the DT/OT I of the System, along with interoperability tests with our allies. Development will also continue on systems to positively identify hostile aircraft [deleted] and improve the utilization and transmission of identification data within the overall air defense $C^3$ network.

Finally, development of the Forward Area Air Defense (FAAD) $C^2I$ (formerly known as Short Range Air Defense (SHORAD) $C^2$ system will provide near real-time information to Division elements to alert the forces of incoming hostile aircraft, provide target location for cuing FAAD weapons, and allow rapid exchange of $C^2$ information among FAAD elements. This capability will assist in protecting divisional elements and maximizing FAAD weapons capabilities. We expect to move to a DSARC II review and enter engineering development in the near future. Air defense weapons effectiveness will significantly improve as the system begins fielding in the early 1990's.

c. Electronic Combat.

Electronic Combat (EC) focuses on the capability to target, disrupt, deceive, and exploit hostile electromagnetic equipment and systems, while protecting friendly forces against such actions. It includes the coordinated use of: (1) self-protection jamming; (2) escort, stand-off, and $C^3$ countermeasures ($C^3$CM); (3) tactical surveillance and electronic support measures; (4) lethal and nonlethal techniques; and, (5) tactical deception using electronic means.

The strategy of U.S. forces is to counter the enemy electromagnetic threat by employing a balanced mix of lethal and nonlethal countermeasures combined with tactics. Therefore, we are developing onboard self-protection systems to protect our penetrating aircraft from enemy [deleted] stand-off jammers to neutralize warning and [deleted] and anti-radiation missiles to destroy enemy surface-to-air missile systems. More advanced techniques are under development to counter protected enemy advances in [deleted].

The major EC efforts under way today are directed toward employing integrated EC systems to keep pace with a rapidly changing and expanding enemy threat and continuing the emphasis on joint Service programs to maximize return on investment and reduce unnecessary duplication. Supporting this approach, the recently published first edition of the DoD Electronic Warfare Plan is an important first step toward achieving an improved, integrated EC acquisition and investment strategy that provides the framework for future development. Unfortunately, there are too many EC programs in some form of difficulty. We must do a better job in managing these programs at the Service level and in oversighting them in OSD.

In the area of self-protection jamming, we are making improvements in the performance and quality of on-board systems for tactical aircraft. A major new system under development to significantly increase self-protection capabilities is the Advanced Self-Protection Jammer (ASPJ). The AN/ALQ-165 ASPJ is a joint Navy and Air Force program to provide an effective Defensive Electronic Countermeasures (DECM) system for the self-protection of both Navy and Air Force tactical aircraft. The ASPJ has completed a major portion of Phase II Full Scale Development (FSD), and prototype ASPJ systems are now being produced and fielded for testing. However, the program has [deleted]. We are watching the program very closely and will be conducting monthly reviews with the program office. As a result of this initiative, we will be giving the program additional oversight attention. Additionally, we have initiated the source selection for a self-protection electronic countermeasures system for F-111 aircraft. For these electronic countermeasures programs, we are also initiating R&D efforts to incorporate [deleted] techniques into these systems as part of preplanned product improvement ($P^3I$) programs. These techniques were developed under the HAVE EXIT program and are undergoing extensive flight testing.

In addition to the internal countermeasures systems, there are [deleted] aircraft which require electronic countermeasures pods. These aircraft do not have the space, wiring, or cooling for an internal system. As a result, we are procuring ALQ-131 Block II pods and modifying the ALQ-119 pods which were built in the 1971-1976 time period. In addition to these efforts, we have structured a competitive program, called SEEK RAM, to provide a pod with [deleted] capability and high reliability. The specifics of the overall DoD EC pod strategy are in review to ensure that we are on an optimum path. I expect changes in the overall strategy as a result of this review.

Similarly, concentrated efforts are under way to provide new and improved radar warning receivers to enable our tactical aircraft to handle the complex threat radar signal environments that will be encountered in future conflicts. Last year, we planned to initiate production of the ALR-74 for the F-16C's. However, the ALR-74 prototype experienced [deleted] which required a thorough evaluation of alternative radar warning receiver systems. The ALR-56C, planned for the F-15C/D/E's, appeared to be a viable candidate. As a result, we have structured a competitive program of the ALR-74 versus ALR-56M. The competitive program is currently in Phase I with a June 1986 review. For the F-111 requirements, we are proceeding with an upgrade to the currently installed ALR-62. (In 1985, we examined the ALR-74 for the F-111's instead of the ALR-62, under Congressional direction, but the ALR-74 would not meet the [deleted] requirement.)

For the Navy's surface ships, the primary thrust is to provide self-protection for combatant ships and aircraft carriers. There are currently more than [deleted] operational AN/SLQ-32 and AN/SLQ-17 self-protection systems on Navy ships today, with a planned deployment of approximately [deleted] additional systems per year through FY 1991. Our FY 1987 development efforts will continue to address electronic decoys, countermeasures against monopulse radar tracking, and additional systems improvements needed for reliable and effective self-protection.

In addition to the self-protection programs, we have an extensive program for upgrades to the EF-111's, EC-130's, and EA-6B's. These systems provide the capability to degrade the enemy's $C^3$ systems.

The Army's major EC and $C^3$CM programs are the TACJAM [deleted] jammer, QUICK FIX heliborne system, AN/TLQ-17A ground based system, and various expendable jammers (EXJAM). Major initiatives for FY 1987 include the development of a [deleted] for TACJAM and improvements to the AN/TLQ-17A jammer. The EXJAM program will continue the investigation and development of a family of inexpensive communications jamming devices [deleted].

The Air Defense Electronic Warfare System (ADEWS) is being developed to [deleted]. The ADEWS program will also include the electronic combat and $C^3$CM capabilities previously addressed in the Air Force's [deleted] program. There is a joint review under way to determine if there is a better strategy using components of an Army special access program to greatly assist in this ADEWS mission.

Many new R&D efforts of lesser magnitude are being vigorously pursued [deleted]. The Services are concentrating on a better balance of R&D programs aimed at developing new technologies to support a broader mix of EC assets to penetrate enemy defenses. More emphasis is being placed on [deleted] to confuse and destroy hostile weapons guidance systems. A concentrated effort has been mounted in all the Services to neutralize the enemy use of [deleted] weapons by developing sensors [deleted].

d. Defense-Wide $C^3$ Programs.

The remainder of our $C^3$ programs fall into the category called Defense-Wide $C^3$. These programs provide $C^3$ systems for long-haul communications, headquarters and base support requirements, defense-wide communications between national and theater $C^2$ elements, information processing and display for strategic $C^2$, communications and computer security equipment, and navigation and position fixing.

In the areas of information systems and base communications, we are improving our position with regard to survivability, security, and state-of-the-art modernization. We are continuing to acquire, install and test digital transmission equipment worldwide. The Defense Data Network (DDN), DoD's long-haul digital communications system, is being expanded to accommodate new subscribers, and we are continuing the modernization of aging base level telecommunications plants through the procurement of digital switches and fiber optics. Additionally, modernization of two critical strategic information systems, the NORAD-Cheyenne Mountain ADP system and Worldwide Military Command and Control (WWMCCS) Information System (WIS), is continuing on schedule.

In FY 1987, R&D will be conducted throughout the areas of strategic information systems and defense-wide $C^3$. For strategic information systems, large investments will be made in the WIS modernization and upgrade, including extensive efforts in the application of ADA. To support AW/AA and space defense, R&D will be conducted for operations center upgrades, communications systems replacements, and command center processing display system replacements. In the Defense Communications System (DCS), R&D will be allocated for command and control enhancement to voice communications, secure conferencing, enhancements to packet switching technologies for both voice and data, upgrades in terrestrial transmission facilities, and improvements to Presidential communications support assets.

We are also improving and expanding the application of security equipment and techniques for computer and communications systems. To support the continued growth of ADP operations in government, our research and development efforts are focused on expanding new technologies which ensure proper access to and protection of sensitive data bases. A major initiative within the more mature Communications Security (COMSEC) technology is the development and acquisition of low cost, convenient and secure telephones (called STU-III) for use throughout the Federal Government and the contractor communities who conduct classified or sensitive matters with the government. Other developmental efforts of particular note include initiatives to eliminate hard copy and paper based systems in the nuclear $C^2$ area and initiatives to increase the embedding of COMSEC in host systems, with the added benefits of space and cost savings.

The major program for navigation and position fixing, the Navstar-Global Positioning System (GPS), will provide a significant improvement in our capabilities for navigation, weapon deliveries, force control, precision surveys and many other applications. It is a space-based system with worldwide coverage which provides highly accurate three-dimensional position, velocity, and time information. [Deleted.] The GPS satellites also carry sensors to detect nuclear detonations as part of the Nuclear Detonation (NUDET) Detection System (NDS). Satellite production is continuing and the launch of the first operational satellite is scheduled for 1986. The shuttle loss will delay this launch and, thus, I expect a delay of up to one year in the IOC of the GPS. Deployment of an 18 satellite constellation is still scheduled for 1988, but is dependent on the impact of the shuttle loss. Full deployment of operational user equipment is planned for completion by the late 1990's. Operational deployment of the GPS will provide much needed capabilities that are unavailable under any existing single system or combination of systems.

## V. CONCLUSION

In conclusion, I want to stress that a comprehensive and integrated $C^3$ system is the cornerstone of force readiness and sustainability. As such, it is an essential factor in maintaining a credible deterrence posture. The highlights I have presented illustrate the progress that is being made in reducing the weaknesses in our $C^3$ system and, in turn, enhancing the readiness of our forces.

Goals have been established, plans have been developed, and an initial investment has been made to eliminate serious deficiencies in our $C^3$ capabilities. As a result of this commitment, our $C^3$ systems are being modernized with significant and vitally important capabilities. A critical component necessary for the success of the modernization effort is a vigorous and in-depth R&D program. The FY 1987 budget request for $C^3$ programs will sustain this effort and send the message that the Congress is committed to completing the rebuilding of the $C^3$ systems required for a strong national defense. Your support of our R&D request is urged so that we can not only achieve an integrated and reliable $C^3$ system to complement the broader forces modernization effort, but also to strengthen our deterrence posture today and into the next century. By building the strongest possible deterrent, we are able to protect our interests, while maintaining peace. However, a strong deterrence posture is impossible to maintain without the requisite $C^3$ capabilities.

Mr. Chairman, this concludes my remarks. I would be happy to answer any questions you or the Committee might have. Thank you.

Mr. McCURDY. The only question I have, and I think we have covered it, is that we do need some factual assistance on trying to follow through on PLSS and JSTARS.

Mr. LATHAM. Yes, sir.

Mr. McCURDY. Could I throw in the perspective that because of the budget constraints, that in some of the forces we are going to have to make, that we are going to have to move in the future toward fewer manned vehicles, both from the Air Force but looking at strike systems such as JTCMS and others, standoff capabilities? And from what you are showing, those systems certainly play a major role.

Mr. LATHAM. Yes, sir.

Mr. McCURDY. In the development of those. And I think you will find some support here for PLSS and those others, if we can again convince some of our top policymakers that they have to look at these other systems. One of the critical shortages in the Air Force, the retention rate among pilots is just abominable right now. They just cannot keep them. We are talking about a $2 million investment for pilots that are fighter jocks. We want to fit that $2 million investment in a $40 million aircraft and flying behind the line [deleted], they are really serious about that.

I just have a hard time understanding that concept. We need some data, again, supporting for PLSS and JSTARS and others to help in that.

Mr. **Price**. Are there any questions?

Mr. **Bayer**. Yes, sir.

Mr. **Latham**. Are you involved in the Army's forward air defense, how to restructure that?

Mr. **Latham**. Yes.

Mr. **Bayer**. Could you provide that now or give us at some later date a review of that?

Mr. **Latham**. Let me give you a short summary and I will be more than glad to give you more details for the record. We have I think taken the right approach to this follow-on system, in that we have said that whatever the weapons system is that would replace the defunct Divad, an whatever the command and control system is, and whatever the various other sensors are, we should view that as a system and not look at it as pieces anymore.

As you know, before we had the so-called Shorad command and control a separate program and Divad was a separate program and IFF was a separate program, and so on. What we said is that that is not the way to present the case to the building or to the Congress. We ought to say here are the total pieces of this, and how they all integrate and work together. So if you notice, the word Shorad has disappeared and we are saying forward area air defense [FAAD], meaning division, defense levels system. We are looking at defense at the forward edge of the battle right up front which the Divad kind of system was going to do. We are looking at the division rear defense issue, and then we are looking at the various passive and active sensors that are needed in addition to what might be with the weapons systems in order to make that play with very heavy emphasis on passive systems for identification and tracking of aircraft, and then lastly communications overlay that ties it together. So it has been presented to the Secretary on several occasions as a forward area air defense system. We are looking at those types of weapons and mixes, including, by the way, a weapon that will go after eventually someday, the hovering helicopter that is say 10 kilometers behind a mountain somewhere lobbing at you a laser-guided or other types of smart missile from standoff, but helicopter-launched.

The package is a package, and we have now reached agreement in OSD with the Army on a Secretary of Defense Decision Memorandum [SDDM] that directs the Army how to go and approach this, and we are going to have the entire system, all the pieces, viewed as one DSARC level system. The DSARC, the first one, will be in the July-August timeframe of this summer, to include the command and control, the weapons, everything. Each of the subpieces will be reviewed at a DSARC level, but not through all the formality of the DSARC process, but each six months is the plan now, we will have a major review of the entire program.

The Army has gone out on a request for information for the weapons systems, and they are in the process of ascertaining whether the command and control pieces can go immediately to contract. Since the original RFP has been modified many times since it was first sent out, the Army is starting to move. There is about an $80 million request for the command and control piece in the 1987 budget for the forward area air defense [FAAD] system $C^2$.

Mr. McCurdy. Don, can I ask you this for the record on one thing that you and I talked about earlier. Can you tell us your impression of the proposal which DOD has some interest in now on the omni-Star, which is a platform change from the Landsat, which is a combination of different sensors?

Mr. Latham. Yes.

Mr. McCurdy. That have some capability.

Mr. Latham. Yes.

Mr. McCurdy. Which will in my opinion save us some money.

Mr. Latham. Yes.

Mr. McCurdy. By going to this approach.

Mr. Latham. As you are aware, the administration made a decision to commercialize Landsat. By that I mean literally turn over to a commercial operating organization the Landsat Program, the land-sensing program from space. They—Commerce Department—put it out on competitive bid, and a consortium won that contract. And in there the Government agreed to furnish moneys to help get the Landsat 6 and 7 design built and on orbit, and to set up ground stations and the necessary facilities to transition this to the civilian world. The civilian company would then sell the products from Landsat to worldwide users, and hopefully make a profit out of that. The largest customer, of course, being DOD.

We have found—[deleted]. What happened in the 1987 budget was the Commerce Department was directed by the OMB to remove $100 million from their budget submit for the Landsat Program. That put the program obviously in great jeopardy. We have been working with the Commerce Department and have developed a different approach, which would commercialize both the Landsat and the Metsats into a single spacecraft, having both sensor systems onboard. This would allow us then to go ahead with the programs, both programs, and not require that $100 million. And in fact, by doing this, we believe we can save very substantial money in the out years, Commerce could save something on the order of $170 million, so Defense is very much in support of that.

We intend to take this plan forward to the OMB in about 2 weeks. Commerce will present it and DOD will be at their side supporting that, and the particular BUS that you mentioned, this Geostar, is a combination BUS, satellite BUS, that would handle both the sensor systems, do both missions, and save us the money that we have been talking about. So we are very much in support of that idea.

Mr. McCurdy. Could they be serviced by the shuttle and be reusable?

Mr. Latham. Yes.

Mr. McCurdy. And other sensors later on?

Mr. Latham. Yes.

Mr. McCurdy. For whatever purposes could be added or whatever?

Mr. Latham. Yes.

Mr. McCURDY. And we are saving money. It is an unusual combination.

Mr. LATHAM. It is a good idea. One of the things we will require some help from the Congress is the law that was passed that said we couldn't commercialize the Metsats. We can fix that, I think.

Mr. BADHAM. Mr. Chairman.

Mr. PRICE. Mr. Badham.

Mr. BADHAM. Following up on your comments. On son of Divad, what you describe sounds good, sounds expensive, sounds a long way off. What is the Army going to do in the interim?

Mr. LATHAM. That is a good question. They have gone through a survey of what is available in the world, in the way of gun and missile systems for short-range air defense. It is believed by the Army very strongly that a combination of a gun and a missile system for the forward area defense up near the FEBA is required. Our Air Force has made a strong input to the Army that one of the things that worries them most in close air support missions in fact are those guns called the ZSU-23's and others. The guns make them "keep their head down" and worry them quite a lot, admittedly, at short range.

Second, the Soviet threat in terms of standoff weapons and helicopters in particular has moved out and out and out in range. It is now where we are projecting a Soviet [deleted] in the [deleted]. The reach of a gun is insufficient to do anything beyond about [deleted] kilometers. It looks like the way to handle the threat is a combination of guns to take care of the close-in threats and a missile system that would handle engagements out to approximately [deleted] kilometers.

In surveying the industry, there are a least four systems, some of them foreign, which have a reasonable chance of meeting that requirement, that are in production or very near to production. One is going into production this coming year and was developed by a U.S. firm for the Swiss, for example, so it is possible, if we don't do ssomething stupid, like we did with Roland and say it had to be militarized to U.S. specs when we had a good German system, we could have something in this decade, and something that would probably come very close to meeting the Army requirements. The RFI that is out on the street hopefully will answer that question more definitively.

Mr. BADHAM. What is the range of TOW?

Mr. LATHAM. Just a [deleted] kilometers, probably [deleted] kilometers at most. As you know, TOW is a wire-guided system. The gunner has to hold sights on the target and guide it to the target. It is a very slow missile and not very maneuverable but has some potential, by the way, against a [deleted].

Mr. PRICE. Are there any further questions?

Without objection, the committee will insert a statement from the National Security Agency in the record.

[Statement retained in subcommittee files.]

Mr. PRICE. Mr. Mansfield.

Mr. MANSFIELD. Thank you, Mr. Chairman.

Mr. Latham, three questions about the strategic program which is the highest priority according to the President in his budget submission. First of all, we spoke before the hearing about the deployment of the Ground-Wave Emergency Network or GWEN System. There has been significant public opposition in the press to this, reported in the press. Can you tell us whether that opposition has been effective in slowing down your deployment?

Mr. **Latham**. No; it hasn't. We have had to go through several town hall meetings and things of that nature, but it has now slowed down the deployment of the initial 57 thin-line sites.

Mr. **Mansfield**. Can you tell us whether there appears to be a nationwide organization to oppose?

Mr. **Latham**. There appears to be; yes. Sombody appears to have a well-financed group of people who generally oppose not only these sites but other military installations and initiatives that we have in the country.

Mr. **Mansfield**. And the same people tend to showup at the opposition meetings?

Mr. **Latham**. Yes; they do.

Mr. **Mansfield**. But you do know the source of the funding?

Mr. **Latham**. No; I don't. I don't know who is paying for their airfares and all these other things and going to all these meetings, but there is a reasonably well-organized group of people, who as I say, broadly oppose just about everything we do, and they seem to be well-organized and well-financed.

Mr. **Mansfield**. Thank you.

The second question I had is about the Bruce Blair study on the strategic activity and the vulnerability of it. According to press reports, it has been determined that that is highly classified at the SIOP level. Can you review the situation?

Mr. **Latham**. Yes; the OTA was given clearance, and Mr. Blair in particular, to do a study on strategic command and control, and was cleared to top secret information. He did such a study, and in the process somehow—and we are not sure, although I believe it was, frankly, a classification moved to the SIOP ESI level—extremely sensitive information level—subsequent to having the material made available to him, that he put together a very good report with this highly classified material in it. That SIOP-ESI material comprises about 8 pages in the report of over 100 pages, so there is not very much of it that has that particular material in it.

We sanitized that material out and gave the report back to the OTA and to the Congress, at the top secret level, and they have that available to them. We have had quite a discussion with Mr. Brooks in particular over the access to the report by Members of Congress.

The issue has been the storage of that report over here, and having access by numerous Members and others to the report, which we felt was just inappropriate.

Mr. **Mansfield**. Does this report reveal any vulnerabilities in the strategic communications system that have not been reported to this committee?

Mr. **Latham**. No; that is not the issue at all. In fact, it is very much in sync with what we have done in the Nuclear Weapons Master Plan and other things. [Deleted]. It is extremely sensitive.

Mr. **Mansfield**. My last question has to do with our ever-present friend the blue-green laser. Is the satellite communications program working fast enough in your view, moving fast enough in your view, so that we will have a choice between that and an upgraded TACAMO, or are we going to have to supplant it?

Mr. LATHAM. I would not put those in the same category. Let me start with the upgraded TACAMO E6A Program. It is moving along well now. The Navy and Secretary Lehman in particular is quite supportive. He was asked in testimony just the other day on that point, and does not want to trade that off as his first choice, so to speak, if he had to reduce the budget. It is well underway, and I think doing fine. The 15 new E6A aircraft will be completed and on line, all of them by 1990.

The blue laser is another communications media that has been in R&D with DARPA and the Navy now for several years. The concept being that you would put this laser at synchronous altitude in one or more satellites, probably several, or it could be in an orbit that is highly eliptical also. It would shine this laser energy on the sea, and with breakthroughs that have been made in receiving capability, you can in fact [deleted] so it has a very interesting communications potential.

The technology is not yet mature enough to say you could go ahead, and the decision point is in later 1987 at best as to whether or not you can make a space-qualified laser that will have the lifetime and so on and not require so much power. We don't know how to generate it with solar cells and so on, so there is a technical issue yet to go through.

Mr. DAVIS. Let me follow up on that. You say that the technology is not mature enough yet?

Mr. LATHAM. Yes.

Mr. DAVIS. Why would you drop funding requests in 1986 when we have spent, what, $50 million through DARPA?

Mr. LATHAM. Yes.

Mr. DAVIS. We are now ready to go directly to the Navy. It seems to me to make no sense to take 1986——

Mr. LATHAM. 1987.

Mr. DAVIS. 1987, I'm sorry, and ask for no money. You did not ask for any money this year?

Mr. LATHAM. There is money in the 1987 budget for blue laser, but DARPA is saying now that the technology in that timeframe, fiscal 1987, is such that if you want it, Navy, you have got to take it, and so the Navy has got to now step up to the funding for the blue laser. DARPA is shedding it off and that is why you don't see it in the DARPA budget. I think that is a little premature in DARPA, but remember what happened in DARPA. In this Gramm-Rudman hit and the unallocated RDT&E impact, DARPA lost $80 million in 1986, and they have been really hit, on a percentage basis and in total dollars, rather significantly, and they are probably projecting a similar hit in 1987 or something like that, and as a result decided that some programs are now to a point that if a service wants it, they are going to have to take it. I think it is nothing more than that.

Mr. DAVIS. Did you recommend to the Navy that they put some money in?

Mr. LATHAM. Yes; I have.

Mr. DAVIS. Did they put some money in the 1987 budget?

Mr. LATHAM. Yes; for blue laser.

Mr. BAYER. Mr. Davis, I think there is, what, about $6 million.

Mr. LATHAM. Not a whole lot.

Mr. BAYER. It is not significant. I think it is a reduction over last year's level.

Mr. LATHAM. Yes; it is. It is a reduction, and this is the question, the system in 1987 is either a go or a no-go from a technical point of view. My judgment is they will pass the technical hurdles. They will be able to show that they can build it. The engineers will do that.

Now, the two remaining issues which are paramount and always have been are the costs of the system and the survivability.

Mr. DAVIS. Do you agree with the contractor's figures on the total cost for the two-satellite program?

Mr. LATHAM. No; I don't.

Mr. DAVIS. Do you think they are low?

Mr. LATHAM. They are low. I think they are extremely low.

Mr. DAVIS. How low are they? It is $3.3 billion.

Mr. LATHAM. Yes; I think they are low for several reasons. First of all, the assumption that went into generating just a two-satellite system is not the same assumptions that the Navy has used in prior discussions for things like MILSTAR and NROS for coverage of the ocean areas.

Mr. DAVIS. You think we need five satellites?

Mr. LATHAM. We probably need four to six satellites to get the kind of coverage because with the two-satellite orbit that they calculated in that particular concept, it only was allowing for communications in the northern hemisphere. The southern ocean areas and other areas were just not even covered at all. First of all, there are more satellites. Second, I think the development costs and the launch costs and more importantly the receiver system costs they assume are low, way low. In the receiver case, I would say that they are probably off by a factor of five.

Mr. DAVIS. The total figure is $260 million?

Mr. LATHAM. That is correct. $260 million for 140 receivers, including installations in the submarines. There isn't any way in this world you can do that for this money. That is a very complex receiver. The receiver is about as big as that desk, that sits somewhere on the submarine, and has these very large optic windows in it that gather in the laser light. So you have got to integrate that into the submarine hull, and it has got to be pressure resistant and all those other things, and that is not a cheap thing to do.

Mr. DAVIS. Where do we have the one? Where is this located on the one submarine that we have now? Isn't it just sitting on top of the submarine?

Mr. LATHAM. Yes; it sits on top of the after hull, I believe.

Mr. DAVIS. It has to be integrated?

Mr. LATHAM. The Navy hasn't decided how to put this laser receiver in. There is a possibility it would be integrated into the sail, a possibility of putting it into a housing up on the bow section, but it is just not clear yet, and the R&D and the integration of that is just nowhere near even started, let alone completed, and then I say that the recurring cost to do that on each submarine probably is going to be somewhere between $5 and $10 million a submarine, at least.

Mr. **Davis**. You would support this committee putting in some money?

Mr. **Latham**. Yes.

Mr. **Davis**. For blue-green laser?

Mr. **Latham**. Yes, sir.

Mr. **Davis**. As a matter of fact, we would be foolish not to?

Mr. **Latham**. I think we should continue the blue laser R&D, and we should then decide collectively what to do with it. For example, we have done the aircraft to submarine tests very successfully. I believe that an airborne laser communications device from S-3's and P-3's to submarines might be tactically something very attractive to do, before you had to make the very, very large investment in the space-based laser system. There is a stepping stone to taking this thing into reality. But I think it is a ways off, and it is going to cost for the space-based case a lot more than that contractor brochure says.

Mr. **Davis**. I agree with you, at least I think I do. I think you said that we should not substitute a laser, Blue-Green Laser Program for the E6A Program?

Mr. **Latham**. At this point in time, that is correct.

Mr. **Davis**. I personally don't think we should either, so you recommend that we go ahead with both programs?

Mr. **Latham**. Yes, sir.

Mr. **Davis**. At this time?

Mr. **Latham**. Yes, sir.

Now, what the right amount of R&D is in the Blue Laser Program in 1987 specifically and in the outyears is not clear, because we have to make that technical judgment ball on key components, such as the laser itself, and the solar power supplies. For example, you need [deleted] power at least, raw power, to run this thing. You have got to put special cooling vanes and so on on the satellite. One of the concepts in the way they got that cost down—and I support that—is to take [deleted] and put this thing on it. That is the smart thing to do. You can make a case that the costs, the unit recurring costs for those satellites is about the ballpark, [deleted] but you would have to do this thing in a different way [deleted] in order to keep those costs down.

Mr. **Davis**. Are you prepared to give us the figure that you think we ought to put in there?

Mr. **Latham**. No, sir; I really am not.

Mr. **Davis**. Will you do that before we mark up?

Mr. **Latham**. Yes, sir; I will try; yes, sir.

Mr. **Davis**. I think that would be important to give us a figure. We know what the contractor wants.

Mr. **Latham**. Yes, sir.

Mr. **Davis**. I think you ought to give us the figure.

Mr. **Latham**. Right.

Mr. **Price**. Thank you very much, Mr. Secretary. The committee appreciates your cooperation.

Mr. **Latham**. Thank you, Mr. Price.

Mr. **Price**. The committee will recess subject to call of the chair, until Tuesday, at 10.

[Whereupon, at 11:55 a.m., Thursday, February 27, 1986, the subcommittee adjourned to 10 a.m., Tuesday, March 4, 1986.]

# SDI

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House of Representatives,
Committee on Armed Services,
Research and Development Subcommittee,
*Washington, DC, Tuesday, March 4, 1986.*

The subcommittee met, pursuant to call, at 10:05 a.m., in room 2118, Rayburn House Office Building, Hon. Melvin Price presiding.

## STATEMENT OF HON. MELVIN PRICE, A REPRESENTATIVE FROM ILLINOIS, CHAIRMAN, RESEARCH AND DEVELOPMENT SUBCOMMITTEE

Mr. **Price**. Today the subcommittee will review the administration's request for $4.8 billion in authorization for fiscal year 1987 strategic defense initiative. This request for authorization is the largest of any defense research and development program for this fiscal year.

We realize the importance that the administration has placed on the SDI Program; however, we also recognize the importance of basic research and exploratory development in other areas. Several members have expressed serious concern over the fact that the Defense Advanced Research Projects Agency [DARPA] was cut by 18 percent this fiscal year in order to protect the SDI Program. Other activities were also cut—some by as much as 20 percent—for the same reason.

I believe we all share the President's objective to explore ways to diminish the utility of offensive nuclear weapons. We must ensure, however, that we are not simply throwing money at the problem and that the funds authorized must be used efficiently.

We have the pleasure this morning of having with us the Director of the Strategic Defense Initiative Organization, Lt. Gen. James A. Abrahamson. As an aside, I would like to add that the administration is most fortunate in having a person like General Abrahamson in charge of one of its major programs. General Abrahamson, in all of his previous appearances before this subcommittee, has been an honest and forthright witness. General Abrahamson, I wish to welcome you back before the subcommittee, but before you begin, I would like to recognize Mr. Courter, our ranking minority member.

Mr. **Courter**. Thank you, Mr. Chairman.

I don't have an opening statement. I am looking forward to your testimony, General, and if when my chance comes to ask questions, if I don't give all of them, I have a few for the record. Good to see you here this morning.

Mr. **Price**. You may proceed.

## STATEMENT OF LT. GEN. JAMES A. ABRAHAMSON, DIRECTOR, STRATEGIC DEFENSE INITIATIVE ORGANIZATION

General ABRAHAMSON. Mr. Chairman, and Mr. Courter, I am delighted again to be back before this committee, and I recognize this is the beginning of a very difficult year in terms of the national decisions that must be made. Nonetheless, we believe that we have a prudent program, that it represents a very strong investment in research and development that will go well beyond, in terms of its benefits, beyond the strategic defense initiative all by itself. I will try to show some examples of that.

However, I do believe that there are some basic principles that are worthwhile commenting on, and, therefore, I would like to read some extracts from my written statement for the record. But I will not read the entire testimony.

In addition to that, I do have some slides which I think will put a portion of the program in better perspective, and with your indulgence, I would like to offer that at the end of this section.

Skipping down into page 1, I believe that it is important to reiterate the program goals and objectives as we move into the third year of this program. The goal of the strategic defense initiative, and I add, which has not changed, is to conduct a vigorous program of research on emerging technologies in search of a better basis for a credible deterrence and to strengthen the stability of peace through strategic defense.

We envision that such a pursuit will offer incentives to the Soviet Union to join with us to reduce significantly or even eliminate ballistic missile forces. With this goal as a guide for the program, let me describe for you the progress and status of the SDI as we begin our third year.

Now I will skip to page 4. The part that I am skipping, however, is vitally important, and it is only because of your intimate familiarity with the Russian threat, the extensive efforts that they have made, both in offensive weapons and defensive program, that I skip that. I feel that is an important part of the record.

Going to page 4, an important point I wish to make initially, and it does need to be fully understood, is that we are conducting this program in full compliance with our treaty obligations and our international agreements. The President has directed that the program be formulated in a fully compliant manner, and the Department of Defense has planned and reviewed the program, and will continue to do so, to ensure that it remains within the provisions of U.S. treaty commitments.

Before I discuss the fiscal year 1987 program, I would like to discuss the realities of our program execution to date. Some have asserted that the amounts of money we have requested for research are unprecedented and cannot be spent, I would add prudently. In my testimony last year, I indicated that I felt we would compare very favorably with the other services' research and development obligations and expenditures. In fact, our obligation rate at the end of fiscal year 1985 was 94 percent, higher than the services and DARPA.

I would like to parenthetically lay out something here that is very important. Since the way we operate is through the services and these other agencies, such as the Defense Nuclear Agency, DARPA, each of the services and, frankly, through NASA and other technical agencies as well, this achievement of being able to properly obligate this 94 percent in that first real year of centralized operation of the program represents a dedicated effort and a priority that all of the services and these agencies have placed on this program.

So when I compare it to the other services, I am comparing it to their own records, and it does represent an intensive effort on their part to really properly start a new program, and I, for one, am very thankful and appreciative of all of their efforts to make that happen.

Going back to the testimony, our expenditure of 40 percent was between the levels of the services. As far as SDI being unprecedented in requesting such growth in research and development funding, this is simply not accurate. The Manhattan and Apollo Programs both experienced funding growth in excess of requests submitted by SDI, I would add here, in terms of their initial buildup rate. I would also add neither of those programs had the unprecedented breadth the SDI Program certainly does.

Unfortunately, our requests for funding in previous years have been reduced significantly, forcing us to redesign program execution and planning. In fiscal year 1985 and fiscal year 1986, Congress reduced budget requests approximately 25 percent. Billion dollar reductions have caused us to accept higher program risks, to prematurely down select certain promising technologies and in general pursue a more austere research program. The reduction of the requested budget levels has not, as yet, had the effect of slowing project schedules for the most critical proof of principle experiments, because I felt it was a responsibility that, just as the Congress had to make choices and just as each of the services had to make choices, that this was the prudent way for me to try to direct the program. I appreciate the fact that the Congress did allow us to have the flexibility to do this in order to try to minimize the impact of this billion-dollar cut, which was to do it by making choices.

Now some of these were great technical regret because there are promising technologies and dedicated teams that are out there. But as we got the results of architectural studies and as we looked at countermeasures and achieved a better understanding of what the Soviets can do, we felt we must make choices. Therefore, some programs are moving ahead even faster, however, at higher risk, and other programs had been slowed down to the point that we are investing minimum amounts of money to either finish important efforts and achieve the knowledge base that is required or, in some cases, to pursue just the technology to see if there are, in fact, some important breakthrough efforts that might go ahead.

But the only way we have been able to absorb this major cut has been through decisionmaking on our part, and that has been a very difficult process. It has had the effect of not allowing the SDI to fund the alternative or fallback technologies at an adequate level to minimize program risk. Thus, congressional budget reductions have had a harmful impact on SDI research and forced major program changes. We have been forced to reduce the effort on certain major technologies, such as space-based lasers, prematurely. This will increase significantly program risk and could cause program slippage, thereby delaying completion and increasing total costs. This is but one example of the many reductions we have been forced to make.

In fiscal year 1987, we are requesting $4.8 billion to support research for the SDI. This funding level only attempts to move closer to the levels recommended by the Fletcher study in 1983. It is substantially below that. It is imperative that we restore the funding levels if we are to reach our goal of providing sufficient information to support strategic defense decisions in the early 1990's.

By the way, I would point out that is information not only for the Department of Defense, but also for the Congress to be able to, with confidence, make decisions that say "Yes, this is worthwhile to go forward, that you have proven sufficiently, not only technical feasibility, but also affordability of an SDI so that we could go ahead." So in a sense, what is happening is that we are not only adding program risk, we are reducing our ability to provide you a sound basis for your decision in the future.

Now I would like to skip over to page 12, where I describe the fiscal year 1987 program. However, the part that I have skipped deals with the architectures and the description of where we now have achieved a much better definition of the program. I believe that that is worthwhile and recommend it to you for your later study.

The 1987 program is designed to pursue the technology development and architectural definition previously established. Although it is well beyond the scope of this testimony to mention every program encompassed in the vast array of SDI-related activities being conducted by either the SDIO or the services, I would like to highlight some of the areas where we intend to apply the major thrust of our research effort in fiscal year 1987. This year our research is evolving more from the technology development into major experiments. I will show a chart that shows you how indeed those are distributed later on.

These experiments are more costly, but beyond any doubt, are required in order to answer technology questions. For example, one of the major thrusts is ground-based electronic lasers. You can do all components you would like, but in the end, you can only know that it is efficient and effective and can work and transmit the energy properly through optics and the atmosphere by building an experimental version of such a machine. That means a large investment, and that is what we mean by an integrated experiment.

The very complex details, some of which by the way were envisioned in some of the early planning for the program, so not only have we had to absorb cuts, we have had to add unplanned elements.

One of our major elements——

Mr. Price. Excuse me.

Mr. Battista. General, I don't have a question at this time, but you are alluding to the cuts that Congress has made which have had an adverse impact on your program, and I recognize your requirement to be loyal to the administration, but I don't think they have taken the appropriate action commensurate with probably the most important program in research the President has, and I wonder if you might comment on the fact that your SDIO is located in the building where you can't have the lights and air-conditioning running concurrently and the fact you have had no contract authority and basically those problems created by the Department of Defense or within the administration that have also curtailed your operation, and if you could cover those, I think that would be of interest.

General **Abrahamson**. Yes, sir, I shall. I would like to come back to that, if I may, to answer your question.

One example, that is important in light of the discussion that we have had about the ability to produce software and be able to have a reliable command and control and telemetry and communications system is a national test bed. Now what this is is a ground-operated simulation of an overall system. It will allow us in the future to be able to experiment with the most effective means of producing this kind of reliable command and control system. That was never envisioned in our early planning, there is a clear necessity now. I will comment on the expense of that in fiscal year 1987. There are others that are in the testimony.

The integrated experiments, at the bottom of page 12, are the logical next step. They were never portrayed as being inexpensive but without them the probability of determining if the SDI is feasible is very low.

As we move into fiscal year 1987, I would like to close by highlighting two areas slightly outside the budget request itself. The first is the effort we are making in the area of medical research using the research into free electron laser [FEL] technology. I would like to thank this committee, because even though this may have been a bit of a rough start getting this thing going, it is indeed a very satisfying effort, and it was an initiative of this committee, and we are very pleased now that we are able to proceed with that effort, and I think it is finally on a much better track.

The program has three major components.

## PREPARED STATEMENT OF LT. GEN. JAMES A. ABRAHAMSON

MR. CHAIRMAN IT IS A PLEASURE TO APPEAR BEFORE THE COMMITTEE TO DISCUSS WITH YOU THE STRATEGIC DEFENSE INITIATIVE. THREE YEARS AGO PRESIDENT REAGAN EXPRESSED THE CONVICTION THAT FREE PEOPLE SHOULD LIVE SECURE IN THE KNOWLEDGE THAT THEIR SECURITY DID NOT REST UPON THE THREAT OF RETALIATION TO DETER A SOVIET NUCLEAR ATTACK. AT THAT TIME HE DESCRIBED THE THREAT POSED BY INCREASING SOVIET NUCLEAR ARSENALS, AND HE PROPOSED BOLD STEPS, EMBODIED IN A NEW INITIATIVE, TO ADDRESS THAT THREAT. THIS INITIATIVE CALLED FOR A COMPREHENSIVE AND INTENSIVE RESEARCH PROGRAM TO PURSUE THE ADVANCES IN TECHNOLOGY THAT HAVE THE POTENTIAL FOR STRENGTHENING DETERRENCE BY INTRODUCING A DEFENSIVE COMPONENT TO OUR DETERRENT POSTURE.

I BELIEVE IT IS IMPORTANT TO REITERATE THE PROGRAM GOALS AND OBJECTIVES AS WE MOVE INTO OUR THIRD YEAR. THE GOAL OF THE STRATEGIC DEFENSE INITIATIVE IS TO CONDUCT A VIGOROUS PROGRAM OF RESEARCH ON EMERGING TECHNOLOGIES IN SEARCH OF A BETTER BASIS FOR A CREDIBLE DETERRENCE AND STRENGTHEN THE STABILITY OF PEACE THROUGH STRATEGIC DEFENSE. WE ENVISION THAT SUCH A PURSUIT WILL OFFER INCENTIVES TO THE SOVIET UNION TO JOIN WITH US TO REDUCE SIGNIFICANTLY OR EVEN ELIMINATE BALLISTIC MISSILE FORCES. WITH THIS GOAL AS A GUIDE FOR THE PROGRAM LET ME DESCRIBE FOR YOU THE PROGRESS AND STATUS OF THE SDI AS WE BEGIN OUR THIRD YEAR OF THE PROGRAM.

IT IS NECESSARY TO SPEND A SHORT TIME DISCUSSING THE SOVIET EFFORTS IN OFFENSIVE SYSTEMS BECAUSE CERTAIN POINTS BEAR REPEATING. SINCE 1969 WHEN THE SALT I PROCESS WAS JUST STARTING THE SOVIET UNION HAS BUILT FIVE NEW CLASSES OF INTERCONTINENTAL BALLISTIC MISSILES AND UPGRADED THESE EIGHT TIMES. AS A RESULT, THEIR MISSILES ARE MUCH MORE POWERFUL AND ACCURATE THAN THEY WERE SEVERAL YEARS AGO. THE UNITED STATES, IN CONTRAST, INTRODUCED ITS LAST NEW INTERCONTINENTAL BALLISTIC MISSILE, THE MINUTEMAN III, IN 1969, WHICH HAS BEEN UPGRADED ONCE. IN ADDITION, WE ARE

NOW WORKING TOWARD COMPLETELY DISMANTLING OBSOLETE TITAN II MISSILES. THE ALARMING GROWTH, BOTH IN QUANTITY AND QUALITY, OF SOVIET BALLISTIC MISSILES OVER THE LAST DECADE IS YIELDING A HARD TARGET, FIRST STRIKE FORCE CAPABLE OF ACCURATELY REACHING ITS TARGETS IN MINUTES. THE RESULTING ASYMMETRY BETWEEN SOVIET AND U.S. FORCE STRUCTURES HAS LED TO A DESTABILIZING SITUATION, ONE THAT MUST BE REDRESSED.

AT THE SAME TIME THAT IT HAS WORKED TO IMPROVE ITS OFFENSES, THE SOVIET UNION HAS CONTINUED TO DEVELOP AND IMPROVE ACTIVE DEFENSES. THESE ACTIVE DEFENSES PROVIDE THE SOVIET UNION A STEADILY INCREASING CAPABILITY TO COUNTER THE RETALIATORY FORCES OF THE U.S. AND ITS ALLIES, ESPECIALLY IF THOSE FORCES WERE TO BE DEGRADED BY A SOVIET FIRST STRIKE AS PROVIDED FOR IN SOVIET MILITARY DOCTRINE. EVEN TODAY, SOVIET ACTIVE DEFENSES ARE EXTENSIVE. FOR EXAMPLE, THE SOVIET UNION POSSESSES THE WORLD'S ONLY OPERATIONAL ANTIBALLISTIC MISSILE (ABM) SYSTEM, DEPLOYED AROUND MOSCOW. THE SOVIET UNION CURRENTLY IS IMPROVING ALL ELEMENTS OF THIS SYSTEM. THE SOVIETS ARE ALSO DEVELOPING COMPONENTS OF A NEW ABM SYSTEM THAT APPARENTLY ARE DESIGNED TO ALLOW THEM TO CONSTRUCT INDIVIDUAL ABM SITES IN A MATTER OF MONTHS RATHER THAN THE YEARS REQUIRED FOR MORE TRADITIONAL ABM SYSTEMS. THE SOVIET UNION ALSO HAS THE WORLD'S ONLY OPERATIONAL ANTI-SATELLITE (ASAT) CAPABILITY. IT HAS AN EXTENSIVE AIR DEFENSE NETWORK, WHICH IS CONTINUING TO IMPROVE, AND IT IS AGGRESSIVELY IMPROVING THE QUALITY OF ITS RADARS, INTERCEPTOR AIRCRAFT, AND SURFACE-TO-AIR MISSILES. THE LATEST SOVIET SAMs, THE SA-10 AND SA-X-12, ALSO ARE CAPABLE OF COUNTERING TACTICAL BALLISTIC MISSILES AND POSSIBLY EVEN SOME STRATEGIC BALLISTIC MISSILES. IT ALSO HAS A VERY EXTENSIVE NETWORK OF BALLISTIC MISSILE EARLY WARNING RADARS. ALL OF THESE ELEMENTS PROVIDE THEM AN AREA OF RELATIVE ADVANTAGE IN STRATEGIC DEFENSE TODAY AND, WITH LOGICAL EVOLUTIONARY IMPROVEMENT, COULD PROVIDE THE FOUNDATION FOR A DECISIVE ADVANTAGE IN THE FUTURE. SINCE THE 1960s, THE SOVIETS HAVE BEEN PURSUING RESEARCH INTO ADVANCED

TECHNOLOGIES FOR STRATEGIC DEFENSE. THESE TECHNOLOGIES INCLUDE HIGH ENERGY LASERS, PARTICLE BEAM WEAPONS, RADIO FREQUENCY WEAPONS, AND KINETIC ENERGY WEAPONS. MOREOVER, DURING THIS SAME PERIOD, THE SOVIETS HAVE HAD AN ACTIVE AND EXPANDING MILITARY SPACE PROGRAM. THIS INFORMATION ONLY REINFORCES OUR NEED TO PURSUE THE SDI'S RESEARCH PROGRAM AS EXPEDIOUSLY AS POSSIBLE.

ONE POINT I WISH TO MAKE INITIALLY NEEDS TO BE FULLY UNDERSTOOD: WE ARE CONDUCTING THIS PROGRAM IN FULL COMPLIANCE WITH OUR TREATY OBLIGATIONS AND INTERNATIONAL AGREEMENTS. THE PRESIDENT HAS DIRECTED THAT THE PROGRAM BE FORMULATED IN A FULLY COMPLIANT MANNER, AND THE DEPARTMENT OF DEFENSE HAS PLANNED AND REVIEW THE PROGRAM (AND WILL CONTINUE TO DO SO) TO ENSURE THAT IT REMAINS WITHIN THE PROVISIONS OF U.S. TREATY COMMITMENTS.

BEFORE I DISCUSS THE FISCAL YEAR 1987 PROGRAM I WOULD LIKE TO DISCUSS THE REALITIES OF OUR PROGRAM EXECUTION DATE. SOME HAVE ASSERTED THAT THE AMOUNTS OF MONEY WE HAVE REQUESTED FOR RESEARCH ARE UNPRECEDENTED AND CANNOT BE SPENT. IN MY TESTIMONY LAST YEAR I INDICATED THAT I FELT WE WOULD COMPARE VERY FAVORABLY WITH THE OTHER SERVICES' RESEARCH AND DEVELOPMENT OBLIGATIONS AND EXPENDITURES. IN FACT OUR OBLIGATION RATE AT THE END OF FISCAL YEAR 1985 WAS 94 PERCENT, HIGHER THAN THE SERVICES AND DARPA. OUR EXPENDITURE OF 40 PERCENT WAS BETWEEN THE LEVELS OF THE SERVICES. AS FAR AS SDI BEING UNPRECEDENTED IN REQUESTING SUCH GROWTH IN RESEARCH AND DEVELOPMENT FUNDING, THIS IS SIMPLY NOT ACCURATE. THE MANHATTAN AND APOLLO PROGRAM BOTH EXPERIENCED FUNDING GROWTH IN EXCESS OF REQUESTS SUBMITTED BY SDI.

UNFORTUNATELY, OUR REQUESTS FOR FUNDING IN PREVIOUS YEARS HAVE BEEN REDUCED SIGNIFICANTLY, FORCING US TO REDESIGN PROGRAM EXECUTION AND PLANNING. IN FY 1985 AND FY 1986 CONGRESS REDUCED BUDGET REQUESTS APPROXIMATELY 25 PERCENT BILLION DOLLAR

REDUCTIONS HAVE CAUSED US TO ACCEPT HIGHER PROGRAM RISKS, PREMATURELY DOWN SELECT CERTAIN PROMISING TECHNOLOGIES AND IN GENERAL PURSUE A MORE AUSTERE RESEARCH PROGRAM. THE REDUCTION OF THE REQUESTED BUDGET LEVELS BY CONGRESS HAS NOT, AS YET, HAD THE EFFECT OF SLOWING PROJECT SCHEDULES FOR THE PRESENT PROOF-OF-FEASIBILITY EXPERIMENTS. IT HAS HAD THE EFFECT, HOWEVER, OF NOT ALLOWING THE SDIO TO FUND THE ALTERNATIVE OR FALL-BACK TECHNOLOGIES AT AN ADEQUATE LEVEL TO MINIMIZE PROGRAM RISK. THUS, CONGRESSIONAL BUDGET REDUCTIONS HAVE HAD A HARMFUL IMPACT ON SDI RESEARCH AND FORCED MAJOR PROGRAM CHANGES. WE HAVE BEEN FORCED TO REDUCE THE EFFORT ON CERTAIN MAJOR TECHNOLOGIES SUCH AS SPACE-BASED LASERS PREMATURELY. THIS WILL INCREASE SIGNIFICANTLY PROGRAM RISK AND COULD CAUSE PROGRAM SLIPPAGE, THEREBY DELAYING COMPLETION AND INCREASING TOTAL COSTS. THIS IS BUT ONE EXAMPLE OF THE MANY REDUCTIONS WE HAVE BEEN FORCED TO MAKE.

IN FY 1987 WE ARE REQUESTING $4.8 BILLION TO SUPPORT RESEARCH FOR THE STRATEGIC DEFENSE INITIATIVE. THIS FUNDING LEVEL ONLY ATTEMPTS TO MOVE CLOSER TO THE LEVELS RECOMMENDED BY THE FLETCHER STUDY IN 1983. IT IS IMPERATIVE THAT WE RESTORE THE FUNDING LEVELS IF WE ARE TO REACH OUR GOAL OF PROVIDING SUFFICIENT INFORMATION TO SUPPORT STRATEGIC DEFENSE DECISIONS IN THE EARLY 1990's. THE FY 1987 REQUEST SUPPORTS THE ARCHITECTURE DEVELOPMENT, MAJOR EXPERIMENTS, TECHNOLOGY DEVELOPMENT, AND INNOVATIVE SCIENCE AND TECHNOLOGY RESEARCH TO ACHIEVE THAT GOAL.

OUR APPROACH TO REACHING THE GOAL OF PROVIDING THE DEFENSE OPTIONS NECESSARY FOR AN INFORMED DECISION IN THE EARLY 1990's HAS NOT CHANGED. ESSENTIALLY THE SDI, IN ORDER TO BE EFFECTIVE, MUST BE ABLE TO DETECT THE ATTACK, TRACK, IDENTIFY AND DISCRIMINATE THE TARGET, INTERCEPT AND DESTROY THE TARGET AND TO BATTLE MANAGE AND COORDINATE ALL THESE ACTIVITIES. IN ADDITION, ANY PROPOSED SDI SYSTEM MUST BE SURVIVABLE AND AFFORDABLE. OUR WHOLE PROGRAM IS BASED ON OUR DESIRE TO PROVIDE ANSWERS TO THESE

KEY TECHNOLOGY QUESTIONS TO THE DECISION MAKING AUTHORITIES, i.e. THE PRESIDENT AND THE CONGRESS, AS THOROUGHLY, RAPIDLY AND AS COST EFFECTIVELY AS POSSIBLE. OUR PREVIOUS YEARS' EFFORTS HAVE BEGUN THIS PROCESS AND THE FY 1987 REQUEST EXPANDS THE INFORMATION.

BY LATE FY 1985, PHASE I OF THE SYSTEM ARCHITECTURE AND TRADEOFF STUDY WAS COMPLETED BY TEN INDUSTRIAL CONTRACTOR TEAMS. CLASSES OF ARCHITECTURES FOR BALLISTIC MISSILE DEFENSE WERE IDENTIFIED AND KEY ISSUES IN ACHIEVING THOSE ARCHITECTURES EXPLORED. PHASE II, WITH THE NUMBER OF CONTRACTORS REDUCED TO FIVE, IS EXAMINING THE CLASSES OF ARCHITECTURES AND ISSUES IN GREATER DETAIL. WHILE WE HAVE FOUND A HEALTHY DIVERSITY OF OPINION ON HOW TO RESOLVE KEY ISSUES, WE ALSO EXPECT AGREEMENT ON THE KEY FEATURES OF BALLISTIC MISSILE DEFENSE ARCHITECTURES. POINTS OF MAJOR IMPORTANCE THAT HAVE EMERGED ARE:

o THE MOST ROBUST ARCHITECTURE COMBINES BOTH SPACE-AND GROUND-BASED ELEMENTS. THE SPACE-BASED ASSETS ARE COFIGURED TO PROVIDE EFFECTIVE DEFENSE DURING THE BOOST, POST-BOOST, AND MIDCOURSE PHASES OF THE THREAT TRAJECTORY. THEY ALSO PROVIDE SELF DEFENSE AND PROTECT AGAINST VARIOUS DEFENSE SUPPRESSION THREATS. THE GROUND-BASED COMPONENTS ARE USED TO ENGAGE THE THREAT DURING THE LATE MIDCOURSE PART OF THE THREAT TRAJECTORY AND WITHIN THE ATMOSPHERE AT HIGH ALTITUDES. THE LARGE NUMBER OF OPPORTUNITIES TO ENGAGE THE THREAT WITH THIS ARCHITECTURE LEADS TO AN EXPECTATION OF ACHIEVING VERY LOW LEVELS OF DEFENSE LEAKAGE EVEN IF THE ENEMY PROLIFERATES HIS OFFENSIVE FORCES IN RESPONSE TO OUR DEFENSE.

o WE MUST FULLY EXPLORE TECHNOLOGIES THAT COULD PROVIDE SYSTEMS TO ENGAGE HOSTILE BALLISTIC MISSILES IN THE BOOST AND POST-BOOST PHASES. THE LEVERAGE AFFORDED BY DEFENSIVE ACTION AT THESE STAGES OF A HOSTILE BALLISTIC MISSILE'S FLIGHT CAN BE DECISIVE. CONCEIVABLY, THE HIGHEST PAYOFF AND THE GREATEST RETURN FOR THE DEFENSIVE DOLLAR INVESTMENT WOULD OCCUR IN THESE

PHASES, BEFORE DEPLOYMENT OF A MISSILE'S WARHEADS AND ASSOCIATED PENETRATION AIDS.

o DATA HANDLING, ALONG WITH COMMAND AND CONTROL FOR TECHNOLOGIES, FOR LAYERED DEFENSES MUST MAINTAIN A HIGH PRIORITY WITHIN THE SDI PROGRAM. NO MATTER WHAT EVOLVES FROM OUR RESEARCH IN OTHER AREAS OF THE PROGRAM, RELIABLE, RESILIENT AND RESPONSIVE DATA HANDLING AND COMMAND AND CONTROL CAPABILITIES ARE REQUISITE.

o BEYOND THE BOOST AND POST-BOOST REALM, A HIGH PRIORITY IS TO CONDUCT THOROUGH EXAMINATIONS OF POTENTIAL CAPABILITIES IN OTHER LAYERS. THE CAPABILITY TO PERFORM DEFENSIVE ENGAGEMENTS IN THE MIDCOURSE AND TERMINAL PHASES IS CRITICAL TO THE FULL EXPLOITATION OF THE ADVANTAGES OF A LAYERED DEFENSE.

o GOOD EXOATMOSPHERIC DISCRIMINATION IS ESSENTIAL TO EFFECTIVE MIDCOURSE DEFENSE. IN ADDITION, MIDCOURSE DEFENSE WITH GOOD DISCRIMINATION CAPABILITY CAN OPERATE SYNERGISTICALLY WITH THE BOOST PHASE DEFENSE BY OFFSETTING THE IMPACT OF FAST BURN BOOSTERS ON BOOST PHASE INTERCEPT.

o IT IS HARD TO OVERESTIMATE THE IMPORTANCE OF THE GENERATION OF REALISTIC THREAT MODELS, THE ESTIMATION OF THE VULNERABILITY OF TARGETS TO THE NUMEROUS KILL MECHANISM OPTIONS BEING EXPLOITED, AND THE DEVELOPMENT OF STRATEGIES, TACTICS AND TECHNOLOGY TO ENSURE SYSTEM SURVIVABILITY TO MISSION COMPLETION. THESE ANALYSES AND ESTIMATES WILL PROVIDE THE BOUNDARIES FOR MEASURING SUCCESS.

o SUCCESS IN NEARLY EVERY ELEMENT OF THE PROGRAM IS DEPENDENT ON MAJOR ADVANCES IN SUPPORTING TECHNOLOGIES FOR SPACE-BASED ELECTRIC POWER, POWER CONDITIONING LOW COST DEVICES, SPACE TRANSPORTATION AND LOGISTICS.

o WE MUST ACCELERATE EXAMINATION OF POTENTIAL APPLICATIONS TO THE SHORT-RANGE THREAT. OUR SECURITY IS INEXTRICABLY LINKED TO THAT OF OUR ALLIES. WE CANNOT CONFINE OURSELVE SOLELY TO AN EXPLORATION OF TECHNOLOGIES WITH PROMISE AGAINST LONG RANGE, LAND-AND

SEA-LAUNCHED BALLISTIC MISSILES. THUS, THE ARCHITECTURE STUDIES REINFORCE OUR VIEWS ON THE ROLE OF BOOST PHASE INTERCEPT; DISCRIMINATION OF DECOYS FROM WARHEADS; MIDCOURSE AND TERMINAL INTERCEPT; BASING OF DEFENSE ASSETS IN SPACE; COMMAND, CONTROL, COMMUNICATIONS AND BATTLE MANAGEMENT; AND THREAT MODELING, SURVIVABILITY, AND TARGET VULNERABILITY. AT THE SAME TIME, OUR RESEARCH HAS ALREADY YIELDED IMPORTANT RESULTS FROM EFFORTS SPECIFICALLY ADDRESSING THESE ISSUES.

o IN DISCRIMINATION, WE HAVE SEEN OUTSTANDING PROGRESS IN IMAGING, PARTICULARLY THROUGH PHASED-ARRAY RADAR TECHNOLOGY AND SIGNAL PROCESSING IMPROVEMENTS. EQUALLY IMPORTANT, THE DIRECTED ENERGY EFFORTS HAVE GIVEN US AN APPROACH TO "INTERACTIVE" DISCRIMINATION.

o THE SURVEILLANCE AND SENSOR PROGRAM AREAS HAVE WITNESSED IMPRESSIVE PROGRESS. MINIATURIATION AND ADVANCES IN OPTICAL SENSORS HAVE PROVIDED RAPID GAINS IN SURVEILLANCE TECHNOLOGIES. MULTI-SPECTRAL MEASUREMENTS OF BOOSTER, POST-BOOST VEHICLE, AND REENTRY VEHICLE SIGNATURES HAVE BEEN OBTAINED BY BOTH OPTICAL AND RADAR DEVICES. THESE MEASUREMENTS ALLOW US TO UNDERSTAND THREAT SIGNATURES AND WILL BE USED IN THE DEVELOPMENT OF SENSOR TECHNOLOGY. ADDITIONALLY, WE HAVE ACHIEVED SIGNIFICANT PROGRESS IN TECHNOLOGIES FOR HARDENING OF HIGH DENSITY MICROELECTRONIC PROCESSORS AND INFRARED (IR) FOCAL PLANE ARRAYS AGAINST THE EFFECT OF NUCLEAR RADIATION THAT WOULD BE EXPERIENCED DURING A BATTLE.

o IN THE DIRECTED ENERGY FIELD, WORK WITH ATMOSPHERIC COMPENSATION AND FREE ELECTRON LASER TECHNOLOGIES HAS PROGRESSED TO THE POINT WHERE IT APPEARS THAT THE POTENTIAL FOR LARGE, EFFECTIVE GROUND-BASED LASER SYSTEMS IS VERY REAL.

o IN ELECTROMAGNETIC ACCELERATOR OR "RAIL GUN" RESEARCH WE HAVE SHOWN THE ABILITY TO INPUT HIGH LEVELS OF POWER TO THESE DEVICES FAR SOONER THAN EXPECTED. THIS MEANS THAT HEAVIER-PROJECTILES COULD BE USED AND/OR HIGHER SPEEDS ATTAINED.

o A SIGNIFICANT RECENT ACCOMPLISHMENT HAS BEEN THE MIDCOURSE INTERCEPT OF AN ACTUAL REENTRY VEHICLE BY AN AUTONOMOUS TERMINAL HOMING INTERCEPTOR. THIS EXPERIMENT PROVED THE CAPABILITY OF A NONNUCLEAR INTERCEPTOR LAUNCHER FROM THE GROUND TO DEMOLISH AN INCOMING BALLISTIC MISSILE PAYLOAD OUTSIDE THE EARTH'S ATMOSPHERE AT A CLOSING SPEED OF OVER 20,000 MILES PER HOUR.

o IN HARDENING ELECTRONIC CIRCUITS AND DEVICES FOR COMPUTERS AGAINST NUCLEAR RADIATION, WE HAVE FABRICATED AND TESTED RADIATION-HARDENED, LARGE SCALE, INTEGRATED CIRCUITS THAT SHOW THE POTENTIAL FOR INCORPORATING SIGNIFICANT ONBOARD PROCESSING FOR SPACECRAFT IN HIGH RADIATION ENVIRONMENTS.

o A DISTRIBUTED COMPUTER THAT NETWORKS SEVERAL STANDARD COMMERCIAL COMPUTERS INTO A VIRTUAL MEMORY SYSTEM IS NOW OPERATIONAL. IT IS PROVIDING TEST BEDS FOR BATTLE MANAGEMENT CONCEPTS.

o IN LETHALITY AND TARGET HARDENING, WE HAVE CONDUCTED MANY TESTS TO ANALYZE AND QUANTIFY DAMAGE EFFECTS AND VULNERABILITIES TO RADIATION AND HIGH SPEED PROJECTILES. ONE OF THE MORE GRAPHIC TESTS INVOLVED DESTRUCTION OF A ROCKET BODY BY A LASER ON GROUND RANGE. OTHER TESTS HAVE EXAMINED THE EFFECTS OF X-RAYS ON LASER MIRRORS. OTHER EFFECTS TESTS HAVE SHOWN THAT SMALL PLASTIC PROJECTILES TRAVELLING AT 7 KM/SEC AND IMPACTING ALUMINUM CAN CREATE LARGE CRATERS.

THE FY 87 PROGRAM IS DESIGNED TO PURSUE THE TECHNOLOGY DEVELOPMENT AND ARCHITECTURAL DEFINITION PREVIOUSLY ESTABLISHED. ALTHOUGH IT IS WELL BEYOND THE SCOPE OF THIS TESTIMONY TO MENTION EVERY PROGRAM ENCOMPASSED IN THE VAST ARRAY OF SDI-RELATED ACTIVITIES BEING CONDUCTED BY EITHER THE SDIO OR THE SERVICES, I WOULD LIKE TO HIGHLIGHT SOME OF THE AREAS WHERE WE INTEND TO APPLY THE MAJOR THRUST OF OUR RESEARCH EFFORT IN FY 1987. THIS YEAR OUR RESEARCH IS EVOLVING MORE FROM THE TECHNOLOGY DEVELOPMENT INTO MAJOR EXPERIMENTS. THESE EXPERIMENTS ARE MORE COSTLY, BUT BEYOND ANY DOUBT, ARE REQUIRED IN ORDER TO ANSWER TECHNOLOGY QUESTIONS. THE VERY COMPLEX DETAILS OF TECHNICAL

CONTENT SCHEDULE, COST AND DELIVERABLES IN EACH OF THESE EXPERIMENTS ARE INCLUDED IN OUR CLASSIFIED DESCRIPTIVE SUMMARIES AND THE REPORT TO CONGRESS. I WILL GIVE SPECIFIC EXAMPLES IN MY BRIEFING BUT LET ME MENTION SOME EXAMPLES OF THESE EXPERIMENTS. MAJOR EFFORTS IN FY 1987 INCLUDE THE NATIONAL TEST BED, THE TERMINAL DEFENSE TIER TESTS, THE ENDO-ATMOSPHERIC INTERCEPTOR, BOOST SURVEILLANCE SYSTEM, SPACE BASE BM/$C^3$ AND THE FREE ELECTRON LASER. WITHOUT THE FUNDING TO PROGRESS TO THE INTEGRATED EXPERIMENT STAGE THAT THESE EXAMPLES REPRESENT WE CLEARLY WILL NOT BE ABLE TO ANSWER TO THE SATISFACTION OF OUR DECISION MAKERS THAT WE HAVE SOLVED THE TECHNOLOGICAL QUESTIONS WE FACE. THE INTEGRATED EXPERIMENTS ARE THE LOGICAL NEXT STEP, THEY WERE NEVER PROTRAYED AS BEING INEXPENSIVE BUT WITHOUT THEM THE PROBABILITY OF DETERMING IF THE SDI IS FEASIBLE IS VERY LOW.

AS WE MOVE INTO FY 1987, I WOULD LIKE TO CLOSE BY HIGHLIGHTING TWO AREAS SLIGHTLY OUTSIDE THE BUDGET REQUEST ITSELF. THE FIRST IS THE EFFORT WE ARE MAKING IN THE AREA OF MEDICAL RESEARCH USING THE RESEARCH INTO FREE ELECTRON LASER (FEL) TECHNOLOGY. THE PROGRAM HAS THREE MAJOR COMPONENTS: FEL TECHNOLOGY, PRE-CLINICAL STUDIES, AND FUNDAMENTAL STUDIES IN BIOLOGY AND MATERIAL SCIENCE. IN FY 1985 FUNDS WERE PROVIDED FOR CONSTRUCTION AND OPERATION OF FOUR FEL FACILITIES: TWO AT STANFORD UNIVERSITY, ONE AT THE UNIVERSITY OF CALIFORNIA/SANTA BARBARA, AND A FOURTH AT MASSACHUSETTS GENERAL HOSPITAL. EACH OF THESE CENTERS ARE EXPECTED TO PLAY A MAJOR ROLE IN EXPLOITING FEL TECHNOLOGY FOR BIOMEDICAL/MATERIAL SCIENCES, AND IN TRAINING OF STUDENTS FOR THE FUTURE. SEVEN ADDITIONAL AWARDS WERE MADE TO MULTI-DISCIPLINARY RESEARCH GROUPS THAT WILL MAKE USE OF THESE CENTERS. PLANS FOR FY 1986 INCLUDE ADDITION OF TWO MORE FEL FACILITIES. THE SDIO IS DELIGHTED TO BE ABLE TO APPLY ITS EXPERTISE IN FEL SCIENCE TO THIS VERY WORTHY ENTERPRISE FOR THE BENEFIT OF MANKIND.

SECOND, WE CAN ALSO SHOW PROGRESS IN OUR DEALINGS WITH OUR ALLIES. MANY OF OUR ALLIES HAVE INDICATED SUPPORT FOR SDI RESEARCH AND IN SOME CASES INTEREST IN PARTICIPATING. ON DECEMBER 6, 1985, THE SECRETARY OF DEFENSE AND THE BRITISH DEFENSE MINISTER SIGNED A GOVERNMENT-TO-GOVERNMENT AGREEMENT CONCERNING SDI RESEARCH INVOLVEMENT, AND OTHER ALLIED GOVERNMENTS APPEAR INTERESTED IN SIMILAR ACCORDS. U.S. AND ALLIED SECURITY REMAINS INDIVISIBLE AND WE WILL CONTINUE TO WORK CLOSELY WITH OUR ALLIES TO ENSURE THAT, AS RESEARCH PROGRESSES, ALLIED VIEWS ARE CAREFULLY CONSIDERED. IN ADDITION TO DIRECT PARTICIPATION IN THE PROGRAM, CONTRIBUTIONS BY OUR ALLIES COULD INCLUDE INNOVATIVE UNIVERSITY RESEARCH, INDIVIDUAL EXCHANGES, OR SUBCONTRACTS TO U.S. INDUSTRY.

MR. CHAIRMAN, I HOPE MY TESTIMONY TODAY CAN ADVANCE THE DIALOGUE AND UNDERSTANDING OF WHAT WE HAVE ACCOMPLISHED AND THE FUTURE DIRECTION OF THE SDI PROGRAM. I CONTINUE TO BE EXCITED ABOUT THE PROGRESS WE ARE MAKING AND THE CHALLENGES WE FACE. I LOOK FORWARD TO WORKING WITH YOU, THE COMMITTEE, AND YOUR STAFF IN PURSUING THE STRATEGIC DEFENSE INITIATIVE. THANK YOU FOR THIS OPPORTUNITY TO PRESENT OUR RESEARCH PROGRAM.

Mr. **Badham**. Let me stop you. The subject of FEL, how much do you have in there for your request for this year?

General **Abrahamson**. In fiscal year 1987?

Mr. **Badham**. Yes.

General **Abrahamson**. Let me just offer a brief status of the FEL Program.

As you know, we decided that it was important to go out on a competitive basis, and by doing that, we indeed received more and better ideas than were initially intended. We have funded 11 contract activities, and they represent from—two efforts at Stanford to one at the University of California at Santa Barbara and Massachusetts General Hospital. We have also received a proposal from the University of Utah. And I only mention some of these, from Purdue, Princeton, the University of California at Irvine, Baylor, a large number, and they are indeed showing that they do have real potential.

I have personally reviewed the work at Stanford. I have committed $15 million of our fiscal year 1987 funds to be dedicated to the medical task. I will have to take that, frankly, out of some of the programs and other important areas as we go ahead, but I think the promise of the research warrants that. By the way, there are additional proposals that are being evaluated.

Mr. **Badham**. Let me just ask you a couple more questions, if I might.

The management has been given to ONR. How, in your view, has that management been taken up?

General **Abrahamson**. One of the efforts, as I reviewed this at Stanford, was a request to tie together more closely the technology, the basic free electron technology for medical applications to some of the clinical activities, and I believe that that is an area that we can improve the management, and it will be worthwhile. So we are now, in fact, searching for the right dedicated clinicians who can participate in a very direct way in the overall problem to tie it together more fully than what it is. That was the main recommendation that I got from the researchers.

They also wanted an increased effort made in terms of clinical studies, and I think that that is one of the reasons that we felt that a slight edition was indeed warranted.

Mr. **Badham**. Is the physical, scientific, and biomedical being contained together, or are they being separated?

General **Abrahamson**. The initial decision was they would separate those two. As I indicate, I think there was a reason for that. It seemed to be really two separate tracks, but as we go forward, I think that, in fact, they should not be separated. So I am reversing that decision, finding the right people to put it together.

Mr. **Price**. General, in this area, I have a letter from Dr. Kinnamon. Without objection, I would like to insert that letter in the record. It deals with the Uniformed Services University of the Health Services, concerning their participation in free electron laser for medical research. I would like to insert that in the record.

[The following information was received for the record:]

UNIFORMED SERVICES UNIVERSITY OF THE HEALTH SCIENCES
F. EDWARD HÉBERT SCHOOL OF MEDICINE
4301 JONES BRIDGE ROAD
BETHESDA, MARYLAND 20814-4799

SCHOOL OF MEDICINE

TEACHING HOSPITALS
WALTER REED ARMY MEDICAL CENTER
NAVAL HOSPITAL, BETHESDA
MALCOLM GROW AIR FORCE MEDICAL CENTER
WILFORD HALL AIR FORCE MEDICAL CENTER

3 March 1986

The Honorable Melvin Price
Chairman
Subcommittee on Research and Development
Committee on Armed Services
House of Representatives
Washington, DC 20515

Dear Chairman Price:

It is a pleasure to provide the information you requested regarding the Medical Applications of Advanced Laser Technology (MAALT) Project currently underway at the Uniformed Services University of the Health Sciences with funds provided by the Strategic Defense Initiative Organization. I am providing this information in my capacity as Director of the MAALT Project and Associate Dean for Operations at the University .

Although the University received its first installment of funds for this project in June 1985, I believe we have made considerable progress since that time. For example, the following has been accomplished:

a. A Laser Biophysics Center (LBC) has been established. The mission of the LBC is to provide centralized biophysics support to the Uniformed Services University of the Health Sciences (USUHS) and associated institutions for laser research through procurement, operation, calibration and maintenance of various laser systems.

b. A Ph.D. biophysicist, a B.Sc. physicist, and a secretary have been hired to staff the Laser Biophysics Center. The former is serving as the Director of the Center.

c. Twenty research sub-projects were approved with a start-date of 1 January 1986. These sub-projects were from among forty proposals submitted by University scientists. The broad research areas are:

(1) Whole Organism. The research in this category involves studies of the eye, the effects of radiation on gastrointestinal blood flow, laser therapy of gastric ulcers and various surgical applications of different organs.

(2) Cellular. The research in this category involves studies of cell division, viral replication, effects of laser radiation on membrane functions, cell oxygen metabolism and other cellular level phenomena of interest in preventing and curing adverse medical conditions.

(3) Molecular. The research in this category involves studies of DNA-protein interactions, virus assembly processes, spectroscopy of proteins and nucleic acids, molecular mechanisms of membrane effects, and various other studies that will elucidate the effects of changes at the molecular level on the cellular and whole animal level.

Titles of the individual projects are shown at the Attachment.

d. Equipment in the amount of approximately $1 million has been received and/or ordered to support the research specified in paragraph 1.c., above.

Plans are to utilize FY 1986 funds to continue the research program that has begun. Funding in the amount of $1.5 million for FY 1987 will allow continuation at the present level of operation. Additional monies in the amount of $0.5 million would allow funding of sub-projects now fully approved but not funded.

Ultimately, it is envisioned that the University will be a Center of expertise for Medical Applications of Advanced Laser Technology, including applications of the Free Electron Laser (FEL). It is our hope that over time the resources devoted to this project from the SDI and the Congress will promote the same beneficial spinoffs for medicine that the space program did for electronics and communications.

We appreciate this opportunity to provide this requested information for the record.

Sincerely,

KENNETH E. KINNAMON, D.V.M., Ph.D.
Director, Medical Applications of
Advanced Laser Technology Project and
Associate Dean for Operations

Attachment

## RESEARCH IN THE WHOLE ORGANISM

| TITLE | PRINCIPAL INVESTIGATOR |
|---|---|
| "Gas Exchange and Lung Mechanics in High Frequency Oscillation" | Peter H. Abbrecht, M.D., Ph.D. |
| "Laser Angioplasty of Athersclerotic Vascular" | Robert E. Goldstein, M.D. |
| "Acute and Chronic Effects of Radiation on Gastrointestinal Blood Flow" | Andre Dubios, M.D., Ph.D. |
| "Lasers in Biliary Obstruction: Radiologic Application" | Abraham H. Dachman, M.D. |
| "Laser Fragmentation of Urinary Calculi" | Stephen A. Sihelnik, M.D. |
| "$CO_2$ and Argon Lasers as Adjuncts to Perilymphatic Fistula Repair" | Carlos Gonzalez, M.D. |
| "Application of Laser Doppler Velocimetry for CNS Blood Flow Measurement" | Giora Z. Feuerstein, M.D. |

## BASIC MEDICAL RESEARCH AT THE CELLULAR LEVEL

| | |
|---|---|
| "Laser Inactivation of Cell Division in the Eye" | David C. Beebe, Ph.D. |
| "Astrocytic Response to Selective Neural or Glial Trauma by Laser In Vitro" | Juanita J. Anders, Ph.D. |
| "Laser Microsurgery of Single Axons In Vivo" | David S. Forman, Ph.D. |
| "Applications of Laser Technology to Studies on the Complement Lesion" | Valerie W. Hu, Ph.D. |
| "Carcinogensis by Laser-Induced Multiphoton Processes" | Dvorit Samid, Ph.D. |
| "Effect of Laser Energy on Corneal Endothelium" | Charles F. Bahn, M.D. |

## BASIC MEDICAL RESEARCH AT THE MOLECULAR LEVEL

| | |
|---|---|
| "UV-Laser Raman Spectroscopy of Nucleic Acids" | Margaret I. Johnston, Ph.D. |
| "Protein Structure from Laser Raman Spectroscopy" | Robert W. Williams, Ph.D. |
| "Probing the Molecular Mechanisms of Carcinogenesis" | Esther H. Chang, Ph.D. |
| "Identification of Proteins Involved in AAV DNA Replication and Integration" | Catherine A. Laughlin, Ph.D. |
| "Rapid Kinetics of DNA-Protein Interactions" | Kenneth W. Minton, M.D. |
| "Analysis of Virus Assembly Using Laser Technology" | Kathryn V. Holmes, Ph.D. |
| "Laser-Induced Photolysis for Study of Hormone Receptors" | Tony A. Fitz, Ph.D. |

Mr. PRICE. Are you familiar with his letter to the committee?

General ABRAHAMSON. Sir, I am not familiar with the letter that they may have written to you. The first grant that we made was to—that institution. It was a partial grant intended to get their program started. I would be happy to see what their suggestions are and to evaluate it very carefully.

Mr. BATTISTA. General Abrahamson, last year in the conference, there was some controversy over why is this program funded in SDI? I think the response to that is "Why not?" SDI's principal objective is in saving lives, and here you have a medical application.

I was talking to some research physicians recently, and if this works, it will be a way of dissolving arterial plaque, for example, bloodless surgery, cancer treatment. Do you welcome the program in SDI?

General ABRAHAMSON. Yes, I do, sir.

Mr. BATTISTA. Could we continue to fund it in your——

General ABRAHAMSON. Yes.

Mr. BATTISTA. OK. Thank you, Mr. Chairman.

Mr. DICKINSON. General, unfortunately I have got to leave before we finish with your testimony or with the questioning, and I wanted to just raise one point. Last year, almost a year ago exactly, the Dergundal Conference met in Munich, and this past week the conference met again in Munich. I was not there this year. But the focal point, and every speaker almost without exception mentioned SDI and wanting a piece of the pie, or some attitudes toward it, which is different from other conferences I have attended, because everybody else always, before they wanted to talk about a two-way street, and they are buying more from us than we are buying from them. That was not the concern this time last year. I am told this year, they want to know if we go forward with SDI, what will be our part of it?

What part will NATO allies play, including the French, who are not in the NATO military alliance? What is our relationship now dealing with the European Community, and are they going to be able to bid and come in and do the R&D efforts and so forth, just like American industry? What is our relationship with NATO countries?

General ABRAHAMSON. Sir, I am really delighted to answer that, particularly because I feel you are pointing out exactly what has happened in Europe. A very substantial change in attitude, not by everybody, but by a significant number of people, thoughtful people, as they have now begun to truly understand what the SDI Research Program is, its potential, and how it can add to conventional defenses and conventional defense of Europe and some of the holes in conventional strategy, as well as nuclear strategy that have clearly existed in the European situation.

But your question was not about that, but I am encouraged by not just the European turnaround, but by the interest expressed in many nations, and it is not only in terms of how much money can we get and how can we play economically in the program. At this last Dergundal Conference, if I can paraphrase Mr. Geoffrey Patty, who I think put it extremely well, he indicated, "I think it is similar to what President Kennedy talked about a long time ago." He said that England was pleased to be participating, and the question was not how much can they get, but how much can they give to the program?

And I think that that now represents an important feeling on the part of many of these people. For example, over a week ago, I was in Israel and discussing the potential contribution and the concerns that the Israelis had, particularly, of course, with the very short-range nuclear and conventional ballistic missile threat that is so important, and, frankly, such an omnipresent presence for their very survival. And Prime Minister Perez, and again I have to paraphrase it, said

> Very well, we, in Israel understand that while our adversaries can lose many wars, we can only lose one, and, therefore, we are fully supportive of your concept, because the world cannot afford to lose or even start one nuclear war. If you can help us achieve stability, then we must support this idea.

Now this was not merely a statement of philosophical support, because after that, I visited several Israeli industries, and some of their research establishments and saw that, in fact, they were spending some of their own money doing architectural studies in order to understand how they can contribute to the short-range threat problem.

I saw an example of how one of the research institutes had converted a 30-mm cannon, which is a conventional kind of equipment, into an exotic weapon. I have indicated the Israelis always ask the question "Can we put these rail guns on tanks?" They have already found a way, and they are converting this by removing the breach and putting an electron gun in the back end to a hybrid form of rail gun and doubled the velocity of the projectile already. It is just fascinating. It is also an illustration of how research on the SDI can and will be applied to a very broad range of conventional applications as well, and, therefore, while I share the concern the chairman and others, that there has been a shift and some of the money is being taken from the previous budgets of the various agencies, I think it has to be looked at in total.

For example, the Gramm-Rudman reduction, as well as the other inflation and other reductions cut a substantial amount, and if I remember right, it is on the order of $60 million. I would like to assure I get the accurate number for you.

On the other hand, we have asked them to be agents for us, and they are doubling that amount of money, because they are a competent management organization working on SDI primarily in our lethality, and they are conducting that in an effective way. You should not view this as only a reduction, but, in fact, as a shift in emphasis, but not a total shift, because some of the money that we are investing is conducting programs that they would have independently carried out.

For example, research on the effect of microwaves, which we are conducting within our program. I believe that it is important, and I share in your concern that as our program priority goes forward that it impacts other priority programs in the Department of Defense. That is fair. It is a very difficult choice.

On the other hand, I don't think that you should only think in terms of the top and bottom lines of these various changes. There are really much more indepth efforts, and I would be delighted to answer any detailed questions that either you or the staff may wish to have about what that shift in emphasis means.

Mr. DICKINSON. What I want to know is, how do we deal with our NATO allies?

General ABRAHAMSON. Sir, I am sorry, I got off on the wrong course.

Mr. DICKINSON. I enjoyed what you had to say, but I still want to know——

General ABRAHAMSON. The way we are approaching our ally program is, first, we are allowing each of our allies to try to come to an agreement with us that meets the minimum requirements of a participative program, but one that is most comfortable for them.

In the case of the British, they wanted a separate memorandum of understanding. We signed that, and 10 days ago, I went to the United Kingdom, and we signed the implementing instructions. The essence of that is, No. 1, there is no reserve for allied participation. It is essentially a competitive program. We are convinced that there are contributions like the ones I mentioned in Israel. There are similar ones in each of our allied nations where they can contribute and as a result of that contribution and earlier work that they have done or in some cases where they have a team of people or facility that we won't have to reproduce, we will be able to produce faster and less expensively.

The majority of the contracts will be competitive. In that sense, I think that means the policies that have been laid out by the Congress and the Department of Defense. In some cases, there will be some sole sources that do merit justification, just as there are some sole source efforts that merit funding here in the United States. But the justification for that has to be just as strong and just as effective as they are for an American contract.

With that, I believe, if we have embarked on questions—I would leave it to you, Mr. Chairman, if you would like to ask some additional questions or if you would like to proceed into the briefing.

Mr. PRICE. Does anyone have any questions?

Mr. DARDEN. Yes, thank you, Mr. Chairman.

General, we appreciate you being here this morning. I have expressed to you a very grave concern, we have met in the past, about a substantial portion of the work which is possible might be awarded to our university community because I feel—we have talked about this too—we need more research being done, DOD research specifically, in our universities.

What portion of the funds are allocated to be used in our universities?

General ABRAHAMSON. What we have tried to do, and it has to vary slightly because of the cuts, in our first year of operation we put, and I would like to have some help on the exact numbers here, but we put in small business and in universities dedicated and set aside in a specially managed program we call our Innovative Science and Technology Program. We put I believe on the order of—I am waiting desperately here for some help.

Well, let me come back to the real numbers. But it amounted to a fairly substantial amount of investment in unclassified research in universities. And, by the way, that has been absolutely exciting. I can give you one example to show how important it is and why.

The research must be unclassified. Just one of those universities that is participating with other universities, and when I say universities, I am really talking about individuals, individual researchers. Obviously the universities have to approve the various contracts; however, the contracts are awarded to individual researchers on the merits of their proposals.

But at Auburn University, for example, while we were working on one class of capacitor, fundamental technology that could be very important to us, one that could offer something like a 2,000-time increase in the basic capacity and effectiveness of capacitors, and before they finished that, they came up with a whole new concept, one that is fundamental, a new principle that exceeds our goal by another factor of 10. Now that is really exciting, and they have done that in the space of about a year.

Let me get you your specific numbers now. In 1985, we put some $76 million in terms of other institutions. Now, a substantial amount of that is spread into small business and into our universities, and if I remember right, the university portion of that is something on the order of $35 million. I would like to make sure that I give to you the accurate number, so I will come back and correct it. This breakout is not as good as I would like. We are planning to about double that in this next fiscal year. We think it is important, and we do get real innovative science that is proposed, so I agree with your point, and we think that it is important.

We have to do it within certain rules in order to be acceptable to the university community. We have negotiated and worked on those rules, so we think we have acceptable ground rules, and it is that for any institution, that their ground rules do not allow classified research, we will allow them to proceed up to given milestones on unclassified research. That doesn't mean that further applications to that in the future—when you get down to applications in very specific military systems—might not be classified. But their work remains unclassified.

And we have been very pleased with the outcome of that so far.

Mr. DARDEN. As a brief follow up, I would like to proceed a little further. Would the repeal of the Mansfield amendment be of any value to you in allowing more work to go to universities or individual researchers at the universities?

General ABRAHAMSON. I believe we have set sufficient policies, that it is not a major problem at this point. However, sir, I would like to answer that for the record, because I do know that that had a very substantial unexpected impact back over the several years after it was—put in place, and that it did, even though it may not have been intended to, inhibit university research.

Now, I think that in the program that we have established for our side of the program that we have found ways to, in fact, bypass most of these perceived problems, but I would like to get a more formal answer. I think, however, your question should also be asked in the larger context, not merely of SDI, but in the larger context of university research within the Department of Defense, and I would like to get for the record an answer from the people who are responsible for that, Mr. Don Hicks at USDRE.

[The following information was received for the record:]

### MANSFIELD AMENDMENT

The Mansfield Amendment provides a reasonable criterion for the use of funds authorized to be appropriated to the Department of Defense. Department of Defense policy on funding universities is to select research projects based on technical merit of the needs of the Department.

Mr. DARDEN. Thank you very much. Thank you, Mr. Chairman.

Mr. PRICE. Any other questions? Mr. Badham.

Mr. BADHAM. Back to FEL and funding for just a second, General. Could we have your assurance that you will personally look into the funding matter? There has been some—it is not quite to the complaint stage yet, but there is some concern at some of the university centers about the slowness of the response of ONR in funding some of these programs that are supposed to be ongoing and ready to move, and the only thing lacking right now are the funds that have been authorized and appropriated.

General ABRAHAMSON. Sir, that was one of the reasons for my review at Stanford, and I think some of the researchers have some legitimate complaints. The first thing that—and, by the way, it is not all just one sided here, but I guess if I were to characterize the problem, initially some of the researchers who had good ideas did not expect that we felt that it was going to be necessary to go out and re-examine the program and go competitive, and, frankly, it was my fault that was a late decision. I should have made that decision much earlier, but I didn't understand the scope of interest and effort until we received a series of proposals from various people.

So I accept the responsibility for some of that slowdown, and I regret it as well. But nonetheless, I think we have a stronger and a better program as a result of it.

Now, in addition to that, there have been in certain specific cases where the proposals either have not been adequate or where we have had to go back and do some auditing or come to some agreements. For example, some of the proposals that are being held up right now are being held up for things like this. At Northwestern, they are waiting on an animal care form. That is kind of bureaucratic, but it seems to be part of——

Mr. DICKINSON. Say that again? Waiting on what?

General ABRAHAMSON. Animal care form.

We have to insure that indeed standards of medical research are conducted in such a way that people will not accuse us of improperly using live animal subjects.

So there are some of these, some of them are legitimate, and I can assure you I have pressed on this, and we are now—I think we have greased the skids and broken through some of the problems.

Mr. BATTISTA. I thought you had an agreement with the subcommittee and, in fact, the Congress, all of the research in this area would be conducted in accordance with the standard practices employed by any medical school in the United States.

General ABRAHAMSON. I understand that, sir, but they have some of their own requirements about such things as animal care forms, and we have some in the Department of Defense as well. Frankly, it is the bureaucratic process of getting a responsible contract out there, and I will tell you that with all of the concerns that have been stated over the last year, some of them fairly and some of them unfairly in my judgment. That procurement has gotten to be a major difficult problem in the Department of Defense at all levels, because people are just being very, very careful to insure that it is done responsibly, and in some cases it is inhibiting.

I guess I would like to say that for the record. Some of that blame is ours, some of that blame falls on the Congress, and some of the blame falls on the newspapers for improperly presenting the overall story.

Mr. PRICE. General, many members of the committee have a present interest in receiving this SDI report. Have you any idea when it will be available for members?

General ABRAHAMSON. Yes, sir. It is in the clearance point at this point, and we expect that it will go through the final clearance report procedure and be there on the 15th. That is about the middle of the month. We have tried to provide additional information to the committee informally so that you can have better insight into where we are.

Mr. PRICE. Mr. Battista.

Mr. BATTISTA. General, you know, I have learned one thing in working up here, and that is perceptions are reality regardless of what the facts are, and in response to your question asked by Mr. Dickinson with regard to NATO, I would like to offer a few things you might wish to comment on.

First, I think one of the biggest problems that you face in SDI, and this may be beyond your pay grade, is that of general policy, strategic policy. How, for example, will the SDI relate to an area dispersal system? We can't get those answers from the administration. How does it tie in with our Army's control objectives, what about our objectives? If, in fact, SDI does materialize, how will it be employed in conjunction with a small mobile missile?

Then you have the problem of funding. Indeed some things will have to be cut out, but we have a difficult time, for example, understanding why you would want to fund the mid-infrared advanced chemical laser program just to get a little bit of data on lethality and propagation. To give you an example, Dr. Keyworth, who is no longer at the White House, characterized the program as a real loser, and I will paraphrase him.

He said, I would much rather spend the money building nature trails in national parks than on chemical lasers like that; yet I believe last year you had over $100 million in that program. You know, we just can't do everything the Fletcher Commission highlighted. Perhaps you can comment on that.

And then finally, with regard to NATO, Mr. Dickinson raised the question of the perceptions, and you commented on Mr. Patty's statement. I wouldn't want to identify them in an open session. I would be glad to tell you who they were privately, however.

For example, in France, we were told that the reason the French decided to go with EURECA, one of the principal reasons, was the somewhat cavalier attitude of the United States in presenting the program to them and the options, not you, by the way, other folks. England, in the United Kingdom, they told me they weren't going to impact their current research and development program in any way that would be detrimental in the event that the SDI Program ever was cancelled in the United States. That is, "We will take your money because we are concerned about the brain drain in Europe; however, we are not going to be totally dependent on you, so if you kill your program, we will have a fallback position."

And then I raised the issue with one individual, what happens at that time, when we reach a critical experiment and we are going to demonstrate it, and the Russians protest to the extent that we want to go ahead with it anyway, but the attitude in the United Kingdom may be, "Well, look, this is construed as a violation of the treaty, we may want to bail out."

What I am wondering is, do you have a commitment from these people participating and who will be taking U.S. dollars to go through with an experiment that we might feel, albeit controversial, would be in our best interest and in the best interest of the SDI Program? You might comment on those three points.

General ABRAHAMSON. Yes. First of all, remember the ground rule that I reiterated, in that we are conducting the program within the treaty. And for a substantial part of the early discussions with our allies, they really wanted to understand that, just as Members of the U.S. Congress wanted to understand that. And I think that what it represented was a lack of real examination and appreciation for what the ABM Treaty says and what it doesn't say. It took a lot of discussion in that area.

Now, most of the nations agree with and support this concept, that it ought to be done at least in this period of time within the ABM Treaty, and they also want assurance, and I think we owe that to them, both as a good business enterprise and also because they are our allies, that they understand what they are working on is a project that can legally and properly be worked on within the confines of the ABM Treaty. And by doing that and having that discussion ahead of time, I think we then avoid the situation about which you are concerned.

So in that sense, there are clear areas of the program off limits for them. The area of most vital interest to all of the theaters, not just Europe, but Europe in particular, is the short-range threat. And I believe that what we will see is the most active interest in that area. And, by the way, that is the area where there are no real restrictions on the part of the treaty except the restriction that says we cannot give blueprints from ICBM systems to them for incorporation in other systems. So in those areas, we are not inhibited in a way that concerns us.

Mr. PRICE. Mr. Courter.

Mr. COURTER. Just a couple questions at this point. I know you have more testimony, General. How close are you to, in your opinion, moving toward full-scale engineering development in a ballistic missile defense system, and what would your response be if the Congress authorized and appropriated money for full-scale engineering development?

General ABRAHAMSON. There are certain components in the system which within the treaty we could proceed with. Let me give you one example of that.

You all remember, I think we had a dramatic demonstration in June 1984 of an Army experiment where we impacted with non-nuclear means a warhead that was fired from Vandenberg Air Force Base and intercepted out over the Pacific by an interceptor fired from Kwajalein. The follow-on to that program is called the ERIS missile. That is a large and important contract. It is an area defense concept, I would like now for people who sometimes have misinterpreted ERIS as being terminal defense to get that on the record. It is not. It is an area defense concept.

We have the right within the treaty to proceed not just through research and through development, but into production and deployment of up to 100 of those vehicles if we wish. Because of the shortage of money, I have elected to take on the problem in this way. I don't want to pay for a lot of paper to develop all of the ERIS missiles that go along with a production program. What I want to focus on in this effort is bringing the cost of that system down and solving the main technical problems as quickly as possible. That means use that money wisely to do that.

At that point, if it was clearly the will of the Congress and was approved by the administration, and we were told "Yes, go forward into development and production for that kind of a system," we could do so.

Now, there are other things that fall in that category. The necessary surveillance systems, the satellites, that would allow us to have a capability, and we need them, but we also need them for surveillance capabilties. They could fall in some of those categories. Unfortunately, there are some that don't within the treaty, and until the Nation makes a decision on the treaty, there will be portions of the program that the treaty would limit us in. Is that specific?

Mr. COURTER. Yes. That is satisfactory.

There are, I think, six program elements that you have in the SDI request. As it were, six last year. I think they are called the exact same thing.

General ABRAHAMSON. It is five, sir.

Mr. COURTER. Five. I am sorry. Would it be advantageous, in your opinion, if the Congress merged those program elements so you just have one large program and, therefore, flexibility to move money from what is now one element to another?

General ABRAHAMSON. Yes, sir. I think that would clearly be an advantage in administering the program. I want the teams that are out there to be, first of all, willing and able to move as quickly as possible and then when we see that there is a real advantage, a breakthrough, I want to be able to shift the money into the part that will pay off the most effectively, and that can best be done without the barriers that five different program elements represent.

Mr. COURTER. One last question now, if I may, Mr. Chairman. Maybe you can't anwer this one in open session. But what types of experiments have you been unable to do, restrained from doing because of your compliance with the ABM Treaty?

General ABRAHAMSON. We have at this point structured these experiments right from the very start so that they are compliant. And, therefore, we have to do such things as plan certain experiments without a full demonstration capability, and let me see if I can think of the best and simplest illustration of that.

At some point, a space-based kinetic kill vehicle could be fired, and our objective would be to make sure that be truly as capable as one would like for a boost phase killer or a killer in space of warheads or boosters. I think antiweapon maybe is a better word to use than killers.

But we could not test that if it had the full capability to be a mobile-in-space system. The treaty prohibits that. Therefore, one can get information by conducting experiments that are only partially capable, one where you would test the ability to fire these systems as fast as one would like, and somewhere else prove the ability to guide.

So what happens is we have to put a series of partial tests together, and then we have to try to assimilate that information and some day I will have to be able to try to show you that some of these partial tests will really add up to the capability to have an effective system. Frankly that is going to be the most difficult technical decision the Congress has ever faced. That is one of the reasons we will use simulations and things like that to help us.

But in the end, it won't be one of the kind of decisions, where you can see an F-16 fly and say, "Yes, that meets the requirements of our fighter force." You are going to have to say this thing occurred in a simulation, and firing range, which all adds up to this total capability.

So there are tests that right from the very start we are restricting in order to stay within the treaty, and the implication of it is that it does cost us more money at this point, not a great deal more, but somewhere downstream, it will cost more, and I eventually make a choice for the Members of Congress, as well as those in the Pentagon, to understand and say "Yes, we have demonstrated we should go ahead." That is not a statement we should depart from the treaty. That is a separate policy issue. The implication is that downstream, we are all going to face a very difficult technical decision.

Mr. BATTISTA. Let me reiterate the points. One was how the administration's lack of support has curtailed your operation, not only your facilities, but lack of contract authority. We know some projects have not been adequately funded to the extent necessary because people are considering reductions—second, how SDI fits in with our strategy, how it relates to the mobile missile, for example, and, finally, how programs for which Congress terminated 3, 4, 5 years ago, why these programs are still in the budget and, for example, the midinfrared chemical laser—how much money is in there for mid-1987, and recognizing you could get some lethality and propagation data, you have to ask what is the return on investment? Would I be better off spending $100 million in another area? If you could cover those points, I guess there are four of them.

General ABRAHAMSON. In terms of the support for the program, I believe that while there is always difficulty in working in a bureaucracy the most precious resource in Washington is floor space, and, therefore, we have had to operate out of a building that has not been as effective as one would like, but we have been given strong support in the area we need it. We started out with an interim charter to operate, and a lot of people looked at that charter and saw there were some difficulties with it. That was OK. It was intended to be something that was a start, to see really there had never been an agency like this at the Department of Defense level before.

We have now signed a very strong permanent charter for the organization. One that does give us procurement authority, and since last fall I have been operating with my own procurement authority and using it selectively. There is no way that we could with a small organization let all of the contracts in a responsible, prudent way for billions of dollars' worth of research. You need many, very competent management teams, and we need that.

Mr. BATTISTA. How many people have you been authorized?

General ABRAHAMSON. I think that our authorization right now is 200, and we are slightly building up—I think we have 146 people identified and growing, building toward that number. What is really difficult is finding truly competent people in this area who can contribute. And while there are many good people in many areas, some of these areas are so new, we have had to search for those people.

Mr. BATTISTA. My problem with that is here you are running a multibillion dollar program with 140 people with contract authority. And if I remember correctly, you were on the F-16 Program for a program that was $13 million total, you had a staff of over 300?

General ABRAHAMSON. You got your numbers right, Tony.

Mr. BATTISTA. So now you have a program that is, by anyone's estimate at least $20 billion, and perhaps a lot more, and you have 146 people. Either there were too many people on the F-16 or too few people on SDI.

General ABRAHAMSON. We are building the SDI Program, and I think the number paid off in the F-16 Program. We are building up. It is hard to make that process to find the right number of people, but we are getting people. We have a charter that gives, I think, now the kind of authority, including the procurement authority, that we need, but, as I say, I will execute carefully.

In addition to that, it is not only the SDI, but it is also the Services which need more people. They were authorized exclusively for the SDI Program an additional well over 500 people distributed in the Army and Air Force primarily. The Navy has a smaller part of the program. I think that is a strong statement of support at the levels where the program is being executed. So that was important to me as well.

And, finally, we are in the process of getting a dedicated SDI facility within the Pentagon, but it takes time to get construction operating. So we will probably have to operate in our interim facility for about a year in order to get the construction done. It is just a problem of room, that is all.

Mr. COURTER. Is there anything we can do to help you in that regard? Space or gearing up, hiring of people?

General ABRAHAMSON. Sir, the best thing that you can all do, in terms of helping us, is to understand the scope of the program and why it is that it makes sense in our mind, and I believe we can prove that to you. If you have the time to study it, we need for you to provide an adequate budget for us as we go forward.

Mr. BATTISTA. Could you turn to the policy issue then.

General ABRAHAMSON. The policy issue, of course, we spent a lot of time with arguing and discussing in many forms here. I am not the proper one to comment on the tradeoff between a small missile and SDI and how that works.

Mr. **Battista**. It is not a tradeoff, it is not a question of do we have this or that, the issue is what is our strategic policy, and how does a SDI complement an area disposal system? These are fair questions when you have multibillion dollar investments. How do they relate, how do they tie into arms control? I think until the administration provides those answers, I think your objectives are always going to be under question by some in the Congress.

We have been asking for well over a year now to tie this together, not make commitments, in other words, not be specific in how SDI is going to be employed, but in the general sense, this is how the two systems will play together—I don't like the term synergism, but this is the synergism among the defensive and offensive systems. We are not looking for answers now, like how many fewer ICBM's could we get by with, just how do they play?

General **Abrahamson**. I have always tried to say, sir, that it is a fair point, and I have always tried to indicate that the strategic implications of the SDI Program are, frankly, harder than the technology, and we have been working on that in a very diligent way.

For example, in the last year of the program now, we have conducted probably on the order of 15 full simulated war games and political military strategy games. The results of those are classified, but I would be happy to provide some of that information. There are now strategic reports on the relationship between some of these very highly classified results, and I think that is important for you to see and understand.

However, in terms of the very simple and direct relationships, I think we have made some of those points several times. Now there have been some Members of Congress who haven't been willing to accept it perhaps, but nonetheless, I think that it is straightforward, and let me comment on—at the very simplistic level, the arms control implications, for example.

We think that, No. 1, that a strategic defense initiative can and will offer a great deal more stability, particularly in crises, in the future, and that it does offer a different concept of deterrence. Some people may not have been able to fully grasp or agree with that, but, nonetheless, we have stated that very clearly in many forums. We have said we are interested now in discussing with the Soviets the transition so that they can see it is in their interest, as well as ours, and it should not be a detriment to beginning to reduce offensive missiles at this point in time.

Therefore, we are embarked on a program, and I believe that it is very clear and even the critics of the program will have to say the SDI, maybe not alone, but contributed to bringing the Russians to the table, and for the first time in the history of arms control has elicited from them an offer of reductions.

In nuclear weapons, that has never really occurred in the past. We have always talked about ceilings and limits, but at higher levels than what we have achieved, or than where we were at that one point in time. So I believe we are embarked on a successful program, and that successful program doesn't mean that the SDI is a bargaining chip, but it should be discussed. I, personally, have presented the program to the Soviet delegation in space and in defense so they can understand that and answer their questions.

Part of the strategy for having me present that program to them was so that they could officially understand it, not just sneak around and try to get the information either from our public press or from our clandestine and illegal means. The next question that was asked by Ambassador Kampleman, "Now, how about telling us about your program?" Because part of the strategy, and in my judgment part of the important element in arms control negotiations over there, is when we reach the point of true candor on their side, as well as our own, then we will begin to make very, very significant progress. We are still waiting for that kind of effort.

We should not confuse what is a lot of propaganda and public policy with a very serious arms control negotiation going on. I, for one, am optimistic about that. I think that it has been explained by the President directly to Members of Congress, and we have explained it as well. We are hopeful. If it does not work, if they do not for some reason see that it is in their interest, then the trends have been dangerous enough that it is quite clear that we should be embarked at full speed ahead on a defensive system because it will be a dangerous world indeed that we are going to face. And I think that has been explained.

Now, there are details behind it, some of which are in the classified area, and I think you should have access to that, and we will do our best to provide you much of that information, sir.

Mr. COURTER. General——

General ABRAHAMSON. That is one example. I am sorry, sir.

Mr. COURTER. That is right. Could you state on the record that you can add to your comments if you would like to later on in writing, but could you explain to the subcommittee what a $1 billion cut from the $4.8 billion request would do to your goals and your operation, your research?

General ABRAHAMSON. I think I would have to provide that for the record. One billion is a very specific number. We have thought about that. I think that since we absorbed that size of cut last year, and I can show specifically some of the things that have happened in the program—and let's just go to some of those.

Mr. COURTER. And could you fully answer that question for the record later on?

General ABRAHAMSON. Yes, sir, I shall.

[The following information was received for the record:]

A billion dollar reduction on the FY 1987 budget request would have a substantially negative impact on the Strategic Defense Initiative Program. In the past we were able to absorb the effects of congressional reductions without changing the immediate goal of the program—to provide the foundation for an early 1990's decision—by reprioritizing various research programs. This year, however, we do not feel we can sustain a billion dollar reduction without impacting upon our ability to provide the necessary technical basis for a development decision within the targeted timeframe.

We are in the process of preparing an itemized listing of the effects of a billion dollar reduction on each program element. We will submit those figures to the committee when they become available.

General ABRAHAMSON. Let me just say it would have a major, major impact on our ability to go forward with now what we have reduced down to what we consider to be the essential minimum of programs.

There are some programs that people may not fully agree with, and Mr. Battista brought up one of those. On the other hand, we feel that that—and I will just take that as an example, since I didn't fully answer his question—that is our only large laser in this country, our only large weapon grade laser that gives us full up kind of capability to examine and to understand.

Mr. BATTISTA. General, let me say, so what? The reason I say so what is——

General ABRAHAMSON. It also happens to be one the Soviets are working on.

Mr. BATTISTA. It will never be deployed as a SDI device.

General ABRAHAMSON. That is correct.

Mr. BATTISTA. There are other ways both through simulation, mathematical modeling or better lasers to get that data. We are spending $200 million on a program characterized——

General ABRAHAMSON. No, we are not.

Mr. BATTISTA. That is what I am heading up in your budget. Characterized by the Navy Research Advisory Council as a program that, were it an industry, would be terminated because it has no military utility. That was about 4 years ago.

In a meeting with Senator Warner, myself, Mr. Dickinson; Bob Keyworth described that type of chemical laser as one where he would rather spend the money doing other things, specifically building nature trails in national parks. I have to question at a time when you have serious problems on your hands, like building detectors that will survive a thermonuclear environment, things like that, spending that amount of money. I believe you had $100 million in the 1986 program for that, on something to get a few data points you would best get through either modeling or a better device, and you know specifically which devices I am referring to, and they are not that far out in time.

Perhaps it is a judgment call, but I think the empirical data for the analysis certainly supports the assessment I have that we can get a much better return on investment in other areas.

General ABRAHAMSON. I know you are concerned with that one particular program, and I would be happy to come back and we will go through it again, Tony. On the other hand, I believe that there are very few that, although there are some people who are advocates of one and advocates of another, that we don't have a fairly large consensus that indeed we are working in the areas of highest payoff. And we will come back and try to justify that for you one more time, sir.

Mr. PRICE. Dr. Mansfield.

Dr. MANSFIELD. Thank you.

With regard to the free electron laser, what commitment or agreement have you made with the Department of Energy laboratories to build a prototype free electron laser at Livermoore? And what will it cost?

General ABRAHAMSON. This is obviously an area of management controversy right now. But my commitment is to try to get a free electron laser, an experimental device fully integrated at the White Sands Missile Range as quickly as possible, and as inexpensively as possible. The technical community has looked at that. There are two camps, one camp feels that we can solve some of the potential atmospheric up-link problems with the laser if we have the ability to experiment with that, laser and, therefore, a preliminary, and I think maybe a hasty decision, but a preliminary decision was to allow an amount of integration and then pick up the laser and move it over to White Sands.

We now have a committee that is reexamining that, and that committee will take a very in-depth kind of look, and we will insure that we are embarked on the program with the objective that I stated, which was to get it to White Sands at a more experimentally oriented and useful site, and also I think in keeping with the direction of this committee several years ago.

Dr. MANSFIELD. So your plan is not to build an expensive facility in California——

General ABRAHAMSON. No, we haven't come to a final conclusion on whether or not and how extensive that facility might be. The key question is the objective, which is to get it there as quickly as possible, and if we have to build a partial or maybe a more complete facility at the Livermore Laboratory in order to achieve that objective, then I am getting the best advice that I can in order to ensure that that is a wise decision.

Dr. MANSFIELD. The second question: We note to the press it is your intention to charter a federally funded Research Development Corporation Center. Have you examined the report of previous institutions of this kind, a record which many people don't believe is a very good one, and do you think that you have to have that rather than the privately available analysis from the research community outside the Government?

General ABRAHAMSON. Yes, I have examined it very carefully, and again I have had some of the premier people with experience in this kind of massive program, and in every case, there was some kind of an indepth technical support organization that allowed the program stability, allowed the ability to hire and, in some cases, change, but to hire technical people more quickly than we can get in the Government, and Mr. Battista and I just had a discussion of some of the difficulty of getting people.

Dr. MANSFIELD. At higher salaries?

General ABRAHAMSON. Yes, and this has been very carefully studied, and I have made a recommendation to the Secretary of Defense, that we should go forward with a very small analysis organization which will, in a sense, assist with a system architect.

Now, we are getting some of that information now, and we are getting it from various areas in the private sector. We are getting it from, first of all, the tradeoff architecture studies I have talked about. I thought that was in fact the most effective way to do the preliminary kind of work, and we have gotten two benefits from that. First, we have gotten good analysis from many of them; second, we have educated a large portion of the American industrial sector on our problems.

However, as we go forward, the depth of these analyses and the access that is required to all of the areas of technology, including proprietary areas, means that we really do need to have the ability to have access in what I call squeaky clean advice.

And I guess I would like to make a very important point here. Some of these what appear to be esoteric technical decisions are, in fact, going to swing billions of dollars' worth of business in the future, particularly if the program goes ahead, and I believe that the best way to see that that is not only done correctly, but is done without any undue influence, is to insure that there is an organization that has no other mission in life except to provide the indepth technical support to the SDI Program and does not have additional business interests, such as being in and supporting other areas of private business or other contractors.

They must be, I think, dedicated to what we are trying to do. So what I am trying to establish is not only a responsive technical organization, but also one that will insure that the American taxpayer does get fair and honest advice, and the program director gets objective advice, that while I am sure it is good advice, it doesn't even have the implication of conflict of interest. I think that is going to be very important to this program.

Dr. **Mansfield**. Would such an organization be more like Rand Corp. Project Air Force or more like the Aerospace Corporation?

General **Abrahamson**. I think that it is indepth technical evaluation that is probably half way between the two. The intent is to keep it small, and by small I mean hopefully not more than 100 or 200 very capable technical people. That does not mean we would not call on additional experts when we need them, as with some of the CETA concepts we use now. However, we need an area where all that can come together and real indepth analysis can be made. That is the fundamental rationale for going ahead with this kind of effort. It is still being reviewed, and a final decision has not been made.

However, that is the recommendation of our Scientific Advisory Board. A very strong recommendation from people who saw how vital that was to the development of the ballistic missile. If you recall the Apollo Program did use Bellcom in a similar kind of a way. Any of these major efforts have had that kind of support.

Dr. **Mansfield**. With respect to the red team or analysis of Soviet countermeasures, in your red team activity, have you or do you plan to actually fabricate and build what you think are the best guess of what Soviet target vehicles would be like, and do you expect to test those against the full spectrum of effects?

General **Abrahamson**. Within the limits of what we can do physically. Obviously, we are not going to conduct a nuclear war somewhere in order to test that, but we are going to do some testing. In fact, we are already building the best simulations that we can. We are testing those and trying to test them not only against simulations of the warheads and simulations of the possible boost bus vehicles and such things as that, but we are also then going into the countermeasures and building American versions of what we think Soviet countermeasures might be. We are doing this so that we can indeed understand not just what intelligence might project in the short term, but where they could physically go eventually to insure that we pick out the areas where defense has clear physics advantage or engineering advantage or cost advantage, even if they make substantial progress. That is the philosophy of the program.

And, by the way, I think we have some very capable people doing that, and I will also have to say I am frankly a little bored with some of the, what I consider to be superficial criticism that just is going on when people say, "Oh, a fast burn booster is the answer." I think it is about time that the press and the Members of Congress and the others ask those that assert that the fast burn booster obviates the system to substantiate that claim at a more indepth level.

Because, frankly, we are well past it. We have left all of that so far behind. That doesn't mean we have all the answers yet, but we see the past to the answers, and we are conducting testing. As I say, I am getting a little bored with the simplistic criticism.

Mr. PRICE. Mr. Battista.

Mr. BATTISTA. Before you proceed, on that point, frankly, I agree with you, nothing obviates the necessity for another system. You could make that same case for a $20,000 guided projectile and a $2 million tank. The projectile has its problems as well.

However, I think some of that criticism may emanate from the fact there is a perception that whenever there is a difficult issue in SDI, it tends to be swept aside or under the rug. I know it is not your doing, you don't operate that way.

Let me give you an example, in September 1984, your office convened a survivability group. They came up with answers that, frankly, generated a lot of concern, specifically we have got to do more to enhance the survivability of our components. To the best of my knowledge, that group was never convened, they took up all the copies of the report, and they never convened the panel again. That is not the way to address the issue.

The way to address the issue is you recognize your problems, and you tailor an R&D Program to address those particular issues, be it gallium arsenide, or whatever. I will give you an example. I think you have a lot of money in this year's budget for gallium arsenide, and it is true it will stand a high dose. I am concerned about the dose rate. I am not sure you are familiar with the laser pantography work going on at Livermore.

General ABRAHAMSON. I am familiar with the laser pantography work at Livermore. By the way, I have also looked at some of the concepts that Livermore has laid out in terms of insuring that they can have an EMP-free box to contain some of the cheaper kind of circuitry that goes with it. In fact, I showed one of the very large concepts that teams have laid out, and we are looking at both of those.

Now, what I don't know at this point is whether or not that concept of screening out EMP can be effective at the levels that we want or if it can be applied all the way across the board. Furthermore, and I think this goes on, that the only gallium arsenide research that is going on in the United States funded by the U.S. Government in the Department of Defense is in our program. I have tried to use that as an example of technology that will serve many programs.

It is funded here, but when the budget is cut, you must recognize that in fact we are cutting out benefits that will eventually accrue to many other systems, and, therefore, we are trying to take an enlightened view, but still a focused view, on SDI. Gallium arsenide research is going on in every country around the world, and the only places where there are automated production lines now are the United States and Japan. The only reason we have two automated production lines in the United States, is because we are funding it in this program.

Mr. **Battista**. I was talking to Mr. Courter about important programs being unfunded. Perhaps you could address your views again how that Laser Pantography Program is underfunded.

General **Abrahamson**. It is brilliant work.

Mr. **Battista**. It is very important, but underfunded. They didn't get all their money. I don't know—the entire Cray 1 computer is on a silicon waiver?

General **Abrahamson**. I was going to have that thing sitting here today, but I thought that would be too much showmanship.

Mr. **Battista**. I have it in my office. In any event, they are $3 million underfunded, you would ask how come——

General **Abrahamson**. I have made a commitment to ask those people to find ways to support that. It does support what Mr. Courter said previously, I do need a great deal of flexibility in order to move quickly on some of these things. When I find a team that can move out, as they have in some very effective ways, I have got to have flexibility to take money from wherever I can find it and put it into that kind of an effort.

Mr. **Price**. Mr. Darden.

Mr. **Darden**. Thank you, Mr. Chairman.

I would like to follow up on this concept of increased flexibility. As Director of the program, you ought to have that flexibility. With that flexibility, increased flexibility, would you be able to carry on the program with considerably less resources, in other words, couldn't you do it with a lot less money if you had a lot more flexibility to move the money around in such a way as to meet what the needs were?

General **Abrahamson**. I can answer it in terms of what I have done in the last years. We had a budget cut that was a crippling budget cut. I have been able to minimize the effect—I haven't been able to negate the effect or stop it and say that was worth actually so much money, because the committees did give us the authority and the freedom to move it about from program element number and then to come back and tell you about it afterward, and for that I am very grateful. It has been worth a significant amount in these first 2 years of the program.

The future of all of that flexibility, while it will still be vitally important, I can't give you a number and say it is worth $500 million or it is worth $10 million, but it is surely worth something, and it is surely very valuable. So whatever final judgment that the Congress must make in this difficult year, I would ask again for that same kind of flexibility, and I would also recommend any initiatives would be greatly accepted in terms of ways of simplifying our overall accounting and our flexibility for not just 1 year in the future, but for many years in the future. I think that would be very helpful.

Mr. **Darden**. Thank you, Mr. Chairman.

Mr. **Price**. Any more questions?

Dr. **Mansfield**. A large number of academic groups have joined in efforts to boycott SDI research on the campus, some of these are the best people in the country. Is the success of the SDI effort at risk because these people will not participate?

General **Abrahamson**. The answer is "No." We have many other very, very capable people. I am disappointed, of course. I would like for the merits of the program to be fully appreciated by these people. But if they choose not to, that is certainly their right to do so. That doesn't mean that I won't continue to try to persuade them, we will. I hope that as the program goes forward, they will indeed see the merits, but there are others, very very capable, who are making this program work, just wonderful people.

Mr. **Price**. General, do you have a plan to reconvene the survivability panel?

General **Abrahamson**. Sir I think we have gone past that particular format now, now that we have a red team that is implemented and is going in many, many different directions. And I can give you some of the products of that. For example, I mentioned the fast-burn booster. I now have a report about that thick from the fast-burn booster workshop that deals with those issues. I have other survivability issues at particular times.

So I believe we have gone past that one particular panel into a better management format. Nonetheless, I would be willing to discuss, if you think that there is some things that I missed, I will be happy to listen to that, Tony.

Mr. **Price**. Thank you very much, General. I appreciate your cooperation.

Mr. Courter, do you have questions?

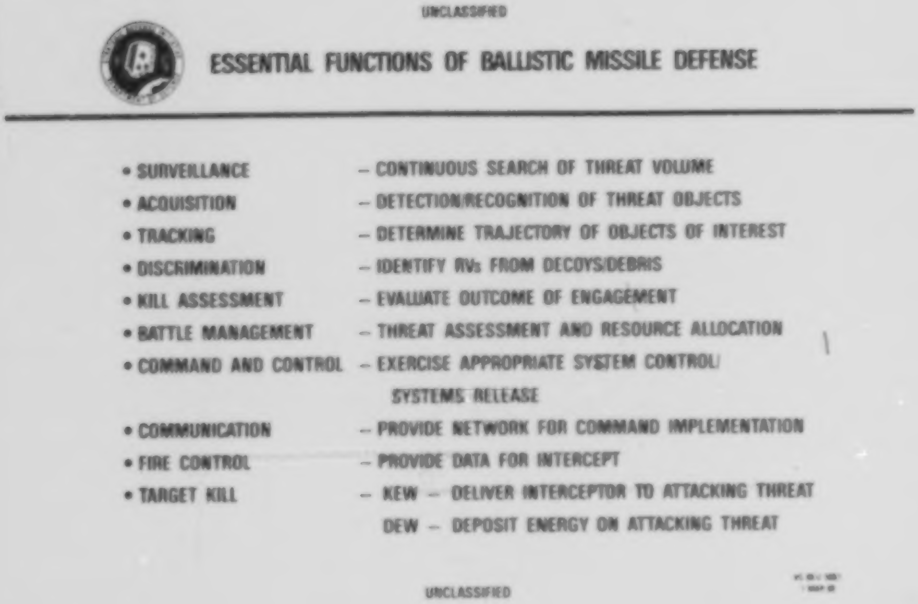
Mr. **Courter**. I was wondering whether the general had some other——

General **Abrahamson**. I do have some slides, sir. We have dealt with many of the subjects. It is your pleasure whether you want to go through some of those.

Mr. **Price**. You may as well do it while you are here.

General **Abrahamson**. All right, sir. I think we can go through a couple of them very quickly. I will try to deal with what I consider to be some of the more important issues.

Again, people may not understand the full scope of the program, and, of course, this is why the investment is so heavy. Investment is the way to look at it, in a broad number of systems that must be there, otherwise you will not be able to carry out the program. So here is a list of functions that must be there for even a partially capable system, and then eventually must become more robust in each area and must function.



UNCLASSIFIED

## ESSENTIAL FUNCTIONS OF BALLISTIC MISSILE DEFENSE

| | |
|---|---|
| • SURVEILLANCE | – CONTINUOUS SEARCH OF THREAT VOLUME |
| • ACQUISITION | – DETECTION/RECOGNITION OF THREAT OBJECTS |
| • TRACKING | – DETERMINE TRAJECTORY OF OBJECTS OF INTEREST |
| • DISCRIMINATION | – IDENTIFY RVs FROM DECOYS/DEBRIS |
| • KILL ASSESSMENT | – EVALUATE OUTCOME OF ENGAGEMENT |
| • BATTLE MANAGEMENT | – THREAT ASSESSMENT AND RESOURCE ALLOCATION |
| • COMMAND AND CONTROL | – EXERCISE APPROPRIATE SYSTEM CONTROL/ SYSTEMS RELEASE |
| • COMMUNICATION | – PROVIDE NETWORK FOR COMMAND IMPLEMENTATION |
| • FIRE CONTROL | – PROVIDE DATA FOR INTERCEPT |
| • TARGET KILL | – KEW – DELIVER INTERCEPTOR TO ATTACKING THREAT<br>DEW – DEPOSIT ENERGY ON ATTACKING THREAT |

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I have divided it into three parts, and if you look on the left, things like surveillance, acquisition, tracking, all of those, they relate to the eyes of an SDI system. You can see on the right-hand side the characteristics of surveillance. For example, we must be able to have a continuous search of a very large global threat volume.

The middle ones are functions I consider to be the brains of such a system, and let me just say, for example, battle management, it must continually be able to, during a very very short-time period, to do threat assessment and allocate all of these resources. So you can see the format I have laid out here for such a system.

Finally, are the weapons that do the actual destruction of such a system. So I have tried to simplify the description of where we are by just thinking in terms of eyes, brains, and weapons or antiweapons.

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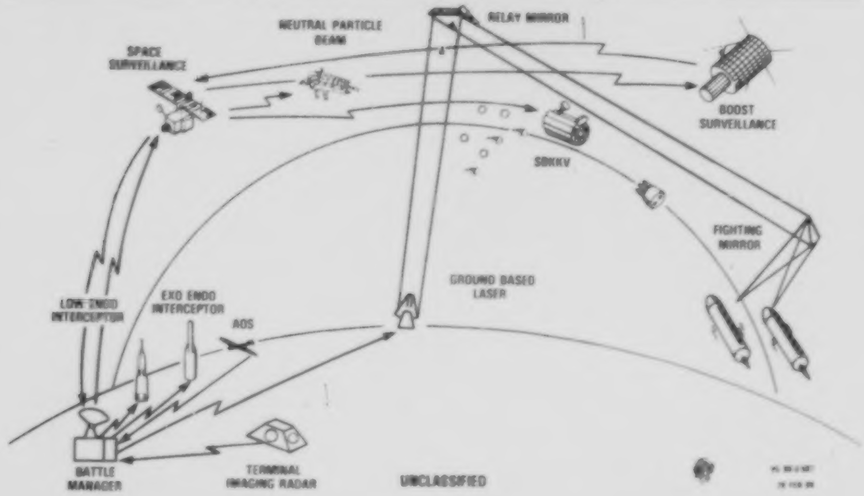
## SURVEILLANCE ACQUISITION TRACKING AND DISCRIMINATION


NEUTRAL PARTICLE BEAM
RELAY MIRROR
SPACE SURVEILLANCE
BOOST SURVEILLANCE
SBKKV
FIGHTING MIRROR
GROUND BASED LASER
LOW ENDO INTERCEPTOR
EXO ENDO INTERCEPTOR
AOS
BATTLE MANAGER
TERMINAL IMAGING RADAR

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Next slide please. Now, many people are confused by the architecture, so again let me go back to the diagrams that many of you have seen. Now if you will look in terms of the colors, you will see why again it is so expensive, because we need to invest in both basic research and some cases integrated research, for here in green are all of the "eyes" elements, and, frankly, we are down to a minimum—in order to be effective—of different approaches to it that are required.

Booster surveillance, we know we need something that can sit up over the Soviet Union and other key places and be able to detect instantaneously when launches begin to occur. We have a Defense Support Program today that shows that that is feasible. We do need to have slight improvements for that.

Now, I would like to emphasize this one, because here is the follow-on to an Operational Surveillance Program today that the research is being done only in our budget, and if that were eliminated, for whatever reason, because of overall resources, what would happen, and what would be the implication of it is that the follow-on surveillance system for the United States, not only for SDI, but also just for missile warning and attack assessment would not be funded.

So here is a program that is a dual use. It will be very, very expensive out in the 1987 and beyond timeframe. This is an expensive satellite program.

Now, that really won't be quite enough, because you also have to be able to discriminate between warheads and decoys. And on the left-hand side of your screen, you see something called space surveillance, and here is an example of how we have operated in order to reduce the funding, and operate it in what I think is a responsible way to take some of the major cuts that we have done. Previously the plan was to build a full satellite, not fully capable, but a full satellite, and test that in space and to be able to see whether or not we can do the kind of discrimination that we are talking about, tell the difference, with heat-seeking eyes on that satellite, between warheads and decoys in space.

As a result of the lack of funds and because I believe that there is a better way of approaching that, I have now taken that program and reduced it into two essential elements. In doing that, by the way, I had to pull back a RFP and obviate or partially obviate the work of a lot of fine contractors and a lot of money that they spent independently on getting ready for this particular proposal.

The way that program is now structured is a ground simulation of all of the data handling system. We think we can do it cheaper on the ground and that we can show on the ground that we have an effective way to do that data handling. It is just cheaper. Hopefully we can get there and demonstrate the capability earlier. There will be more expenses later.

However, that is not enough, because it is not just data handling that we have to generate, it has to have eyes or sensors that can really effectively see those things. So instead of building a fully capable satellite, I have divided the program into two parts. We will do some space experiments, but they will be minimal; they will be just testing the sensors as inexpensively and as early as possible.

But I mentioned earlier that the combination of these things are what we will all have to be able to understand. That is the combination of sensors that we will test in space and see what they can really see under the true environmental conditions, as Dr. Mansfield brought up, as best that we can see them in space without a full nuclear environment, and the ground operation.

So here is a way in which we have reduced the money. But you haven't obviated the money. Later on that will have to be built into a real satellite in the development phase of the program. It will take longer because we will not have gone as fast or as fast as we have indicated here. Now there is an interesting tradeoff. Previously we felt that completely passive detection and passive surveillance would be sufficient to be able to tell the difference between warheads and decoys, and all of the tricks that the Soviets might use. We have now come to the conclusion, based on some of this survivability and countermeasure work that we have done, that passive means may not be enough alone.

Therefore, we are looking at semiactive means to augment that. There are several ways of doing that. One is a ground-based laser, and see if you can take a light decoy and actually move it in space, because you hit it with the energy.

Another way that has already proven from Los Alamos to be quite effective is to eradicate the threat cloud, and it is a cloud, by the way, and it is a frightening cloud, of immense proportions, to illuminate that cloud with a low power with what we call a neutral particle beam. We have seen that we can get a unique signature off of the heavy elements that are in a true warhead and compare that to the lack of that signature in a decoy. And, therefore, that is where one of the tradeoff areas really exists.

We feel you cannot rely solely on objects in space, and we would like to have systems that will support some of the ground-based systems, and so we are working on a terminal imaging radar. If you will allow me just a little bit of show and tell here, I brought the first of an X-Band solid state submarine, which will replace solid wave tubes. For those of you who follow technology carefully, you will know wave tubes are troublesome in all of our systems and for the first time Hughes, Fullerton, CA, has now developed a set of 10 watt solid watt X-Band module, and this is the first time it can be done at low cost and in quantity. We consider this not a breakthrough, but a major extension of our capability and a way to substitute the much lower cost component for what eventually would fit into that terminal imaging radar.

In order to do that, we had to make a whole series of individual kinds of areas of progress in order to produce that particular unit. It replaces rather complex, large and unreliable traveling wave tubes with solid state devices. That is an example of some of the outputs of our research, and it will eventually, if the decision is made to go forward, make that terminal imaging radar possible and affordable, and that is important.

So here are a set of the eyes. That is a large number of programs that have to be pursued at both a technology level and at the integrated experiment level.

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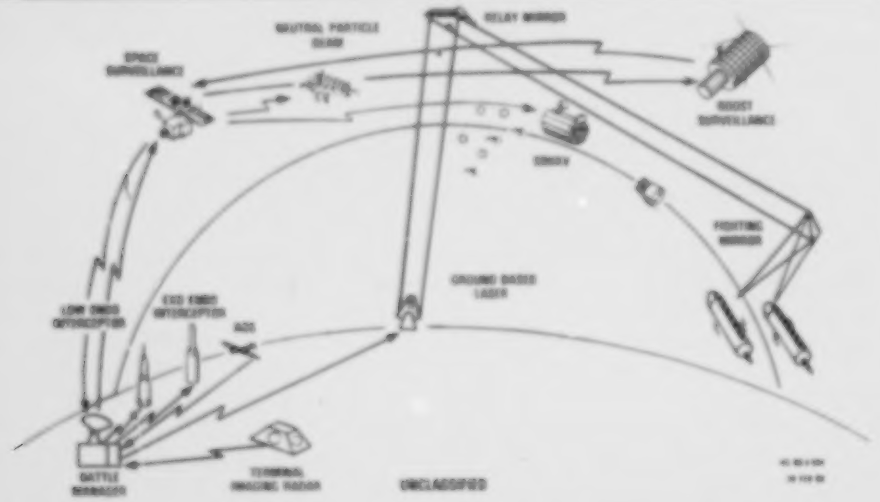
BATTLE MANAGEMENT/COMMAND
CONTROL AND COMMUNICATIONS



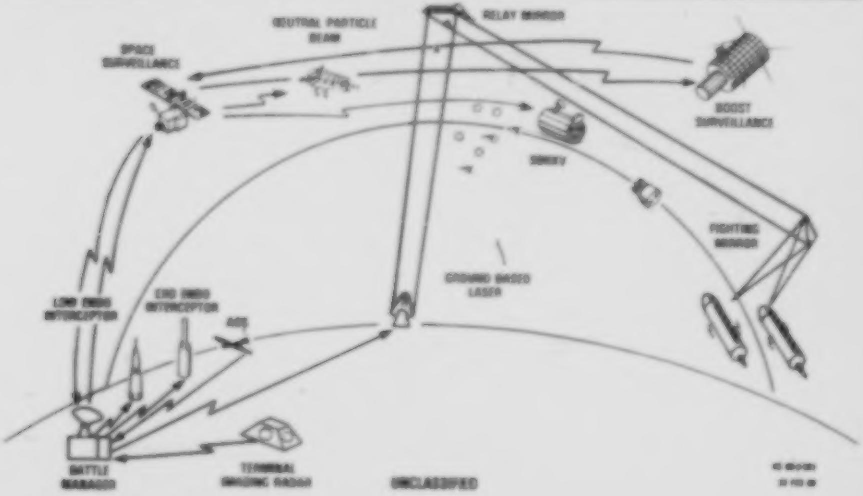
UNCLASSIFIED

Next one, please. The next one is battle management and control, toughest part of the problem, in my judgment. Longest pole in the tent. And it is the one that I think we have a later start on and we are really embarking just as fast as we can correct this problem. We are embarked on a horse race approach, using our contractual authority to move out with this kind of contract concept that we have applied here to get a significant number of companies who can truly participate to build this simulation where we can then test and experiment with simplified command and control technology methods and will also eventually be the place where you will all be able to visit and say, "Yes, I think this will work together." Because it is only in this simulation we will be able to see the separate elements will be able to work together.

Now, that means that there have to be brains in each one of those space-borne and ground-borne systems, as well as out in all of the weapons, and, finally, brought back to a human battle manager where you can insure that we have the best mixture of software and hardware reliability and mixed under human supervision and human control.

UNCLASSIFIED

TARGET KILL


NEUTRAL PARTICLE BEAM
RELAY MIRROR
SPACE SURVEILLANCE
BOOST SURVEILLANCE
SBKKV
FIGHTING MIRROR
GROUND BASED LASER
LOW ENDO INTERCEPTOR
EXO ENDO INTERCEPTOR
AOS
BATTLE MANAGER
TERMINAL IMAGING RADAR

UNCLASSIFIED

Next one, please. And finally we talk about the weapons, and we are reducing the number of weapons and emphasizing certain ones. I would like to point out what those are. Perhaps one of the early ones that is a nondirected energy concept is the kind of a rocket pod in the sky. It is a simple space platform that has a missile on it that will be a low-cost missile that operates in a manner very similar to some of our air-to-air missiles. It will go fast enough to destroy boosters in a boost phase, but can also be used against warheads.

Mr. PRICE. Can you put the remainder of this part of your briefing in the record?

General ABRAHAMSON. Yes, sir. I will close very shortly, if I might.

Mr. PRICE. Go ahead.

General ABRAHAMSON. We are emphasizing what I think is the most cost effective directed energy concept to go with this, and it is the ground-based laser. And I think that our progress over the past year has been very substantial and warrants this emphasis. We are looking, of course, in the short-wave frequencies where it will be easier to operate. But there still are some problems. Now it can operate by bouncing off of mirrors in space and moving forward to destroy the boosters.

Now, the point that I am trying to make is that we have kept that ground-based laser in a high-priority program. Those are going to be very expensive, and they are going to try to go as fast as possible. The others we have tried to minimize, but that is with some regret, because we are seeing some very interesting technical, either breakthroughs or promise of breakthroughs that might change some of these cost equations. They haven't done it yet, so we haven't cut them out, we have lowered the funding levels.

Finally, the missiles, which will be part of the last layers. Now, I would like to spend just 1 minute on the ERIS missile, which would be one of those that would be an area defense that would go outside the atmosphere. If you located it at one side in North Dakota, you might be able to reach with some of our rocket technology we are developing and cover the entire North American Continent with the exception of Mexico. That shows the kind of technology we are searching for in rockets, and I feel that is well within our grasp.

The important point I would like to make about this program is we have already demonstrated technical feasibility, and our challenge now, is to bring the costs down. So the ERIS contractor has a clear mandate to be able to bring in that missile at a level of $1 million or less; and, therefore, we have moved beyond technical feasibility to this question of how can we make this affordable?

A very substantial amount of our research is aimed at that question, insuring that it is affordable. That is why it is important to have an adequate investment in this time, in these many areas, this huge broad range of research, and that is the one bottom line that I would like to leave with the committee. It is expensive, and it is expensive because there are so many different avenues we must carry out. If we can't carry them out adequately, we will never be able to have an affordable concept. We think that we already understand that it is technically feasible, but it must now be affordable. That is the only responsible way that I could recommend to the President and to the Congress.

And, with that, I thank you, sir.

Mr. **Price**. General, how much coordination is there between your office and Mr. Aldridge's office to avoid duplication?

General **Abrahamson**. We have a very active coordination program not only with those elements of the Air Force, but also with all of the services, so that we do not duplicate efforts they are undertaking, and, by the same token, that they get the benefit of our technology. So we do coordinate with all of the services, just as effectively as we can, sir. That takes a lot of effort and a lot of hard work, but I think the country is better off for it.

Mr. **Bayer**. Just one brief question. There seems to be renewed interest in defense in Europe against the tactical ballistic missiles and cruise missiles. I know you all have studied that in your architecture. What are your plans in the future to support that?

General **Abrahamson**. No. 1 is that we would like for European companies and nations to be involved in a more detailed architectural study of that, one that goes beyond architectural studies, but one that says how can we build on some of the systems with the technology we have today, as well as with what they have with a minor investment to move quickly into that area. Therefore, the first step is tradeoff studies in more depth involving more American and European countries.

Out of that I think will come some very effective technical proposals that will allow us to quickly move into systems that will be more capable than where we are today, but that will not have to have such a major technical jump as some of the directed energy systems or some other more exotic systems we are looking at for intercontinental systems. It may be easier.

Mr. **Bayer**. Will your office continue to be the focal point for that, or will it be spun off to the Army?

General **Abrahamson**. We will be the focal point, and all the research efforts will be funded in our area. Remember, the Army has an operational program that deals with that at this point, the Patriot upgrade, and that is completely separate from our activities. We are looking for the next generation of that. We will use the Army, and I have designated the Army as my executive agent to assist in the management of this very broad program primarily because of their experience, but when I say executive agent, it still must involve the other services and the other agencies.

Mr. **Price**. Thank you very much, General, for your presentation this morning.

The subcommittee will adjourn now until tomorrow at 2 o'clock.

General **Abrahamson**. Mr. Chairman, thank you, it is a privilege always to come to this committee.

[Whereupon, at 12 p.m., the subcommittee was adjourned until 2 p.m., Wednesday, March 5, 1986.]

# ARMY BUDGET REQUEST FOR FISCAL YEAR 1987 RESEARCH, DEVELOPMENT, TEST, AND EVALUATION PROGRAM

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House of Representatives,
Committee on Armed Services,
Research and Development Subcommittee,
*Washington, DC, Wednesday, March 5, 1986.*

The subcommittee met, pursuant to call, at 2:20 p.m., in room 2212, Rayburn House Office Building, Hon. Melvin Price (chairman of the subcommittee) presiding.

## STATEMENT OF HON. MELVIN PRICE, A REPRESENTATIVE FROM ILLINOIS, CHAIRMAN, RESEARCH AND DEVELOPMENT SUBCOMMITTEE

Mr. Price. The subcommittee will come to order.

This afternoon, the subcommittee will review the Department of Defense request for authorization of $5.5 billion for the Army's fiscal year 1987 research, development, test, and evaluation program.

Our principal witnesses today are the Honorable Jay R. Sculley, Assistant Secretary of the Army for Research, Development, and Acquisition; and Lt. Gen. Louis C. Wagner, Jr., USA, Deputy Chief of Staff for Research, Development, and Acquisition.

Dr. Sculley and General Wagner, it is a pleasure to have you back before us again this year. I would add that this will be a most difficult year in light of budget constraints. We say that every year. Maybe it won't be too bad.

Accordingly, I doubt seriously that you will get $5.5 billion by the time the appropriations process is complete, and therefore we are going to have to make some difficult choices.

I know that there is a great deal of concern over several Army programs to include the Copperhead guided projectile, the LHX helicopter program, the fiber optic guided missile, to name just a few.

Mr. Badham, would you have any remarks?

Mr. Badham. I have Mr. Dickinson's statement which I will enter into the record, and I will deliver it, because I share a lot of his concerns.

I would like to welcome Secretary Sculley and General Wagner to the subcommittee to support their request for $5.6 billion in fiscal year 1986.

Mr. Dickinson says there are a number of areas he would like to have you—and I share that—specifically cover today in your testimony.

Mr. Dickinson has asked, and has been supported, previous witnesses to provide their thoughts on a 2-year authorization and appropriation budget cycle.

He has also raised the question which the committee is interested in of helicopter air-to-air, and to be kept up to date on what you are doing in that area.

Also, he suggests—and I would, too—since you have had time to re-think to a degree the entire issue of forward area air defense, following the cancellation of Sergeant York, that we should spend quite a bit of time on that so the members might understand what the requirements are and how soon we might expect to have that void filled with capability in the field.

I, on behalf of Mr. Dickinson, thank you, Mr. Chairman.

Mr. DICKINSON. You did that real well.

Mr. PRICE. Well, Bill, do you want to add to it?

Mr. DICKINSON. No, Mr. Chairman. He took the words right out of my mouth.

Mr. PRICE. You may proceed, Dr. Sculley.

## STATEMENT OF HON. JAY R. SCULLEY, ASSISTANT SECRETARY OF THE ARMY FOR RESEARCH, DEVELOPMENT, AND ACQUISITION, DEPARTMENT OF THE ARMY

### RDA OVERVIEW

Dr. SCULLEY. With your permission, I will submit my prepared testimony for the record and only make some very brief remarks before getting into the substance.

Mr. PRICE. Your statement will be included in the record.

Dr. SCULLEY. First, the Army must acknowledge the fine support provided by this committee in the past. It has been that support that has allowed us to make significant advancements toward the challenge of providing our fighting force with state of the art war-fighting technology.

I understand the difficult fiscal constraints in which we operate today, but with your permission let me review with you the Army policy on where to make our reductions.

Our appropriation for fiscal year 1986 in procurement was $18.8 billion. Our request for fiscal year 1987 is $18.6 billion, or a real decline of 5.2 percent after inflation.

In RDT&E, our fiscal year 1986 appropriation was $4.8 billion and our fiscal year 1987 request is $5.6 billion, or a real growth of 10.9 percent.

Taken together, however, Mr. Chairman, the RDA accounts are nearly at zero percent change, and I think it is essential that we place the investment growth in RDT&E in proper perspective.

I feel that the RDA accounts have met the Gramm-Rudman-Hollings objective, and we have made a corporate decision in the Army to emphasize our future war-fighting capability.

At this time, with your permission, sir, General Wagner will discuss some of the details of the program contained in our fiscal year 1987 request.

## Prepared Statement of Hon. Jay R. Sculley

Mr. Chairman, members of the Committee: It is a privilege for me to appear before you to present the fiscal year 1987 budget request for the Army's Acquisition Program.

Fifteen years ago we recognized the need to modernize in all areas, but particularly in our principal weapon systems.

At that time the Soviets were developing and deploying weapon systems at rates which indicated that they intended to establish a clear numerical superiority over the U.S. and its NATO Allies in terms of modern conventional military forces.

The Soviet forces and those of the other Warsaw Pact members were then already numerically superior but inferior in the quality of their equipment. Accordingly, the U.S. and our NATO Allies enjoyed a substantial qualitative superiority.

The deterrence of our conventional forces depended largely upon the uncertainties that this qualitative difference created for the Soviets.

The modernization program upon which we had embarked in 1970 was designed to exploit our technology and to use it to field new systems which would maintain our margin of qualitative superiority. With your support, that program has gone well. We have developed modern systems and are now acquiring them and modernizing our force.

General Wagner will be discussing in some detail our current status and what our fiscal year 1987 request will accomplish.

As we have proceeded with our modernization program, the Soviets have moved much more aggressively than any of our estimates predicted. They have increased their numerical advantage more than expected and, more alarming, have reduced and, in some cases, reversed the qualitative advantage we held.

In Europe this means that Soviet and Warsaw Pact forces have fielded a modern motorized and armored force, and dense multi-system air defense, modern attack aircraft and helicopters, and a growing conventional tactical missile threat. Thus, at least by many of the measures which we have used to compare our forces, we have indeed lost ground. In these respects, the uncertainties for the Soviets in conducting a conventional campaign in Europe have been reduced and so, accordingly, has the deterrent posture of the U.S. and NATO forces.

At the same time, the military situation in the third world has worsened. Soviet military power and influence have been increasingly projected there. In Southeast Asia, in particular, Soviet military equipment has been used to establish large and modern mechanized and armored forces. These and developments in Africa and Latin America confront us with a militarized Third World in which the prospects for U.S. military operations are becoming increasingly formidable.

While we have been modernizing, the Soviets have been increasing their numerical advantage and eliminating the qualitative gap. In the area of quality, the Soviets have done this, at least in part, by acquiring our technology. Had we depended only on equipment modernization, our difficulties now would be very serious, if not extreme.

However, as these Soviet developments emerged, our military planners recognized the need to meet them, first, by developing new doctrine for the employment of our new weapons and, second, by devising new organizations for our light forces, as part of the army of exellence program, to meet our new and increasing worldwide commitments.

Airland battle is a major advance in doctrine which addresses the battle activity in the rear, close-in, and deep areas as concurrent, coordinated operations.

This doctrinal development is particularly bold in its concept for deep attack, that is, projecting combat power deep to attack the second and third echelons of the enemy force. This aspect of airland battle is generally described as producing delay, distribution, and attrition of these echelons but, by doing this, it does much more. Deep attack in airland battle places the whole concept of Soviet campaign operations at risk.

Thus, as we implement this doctrine, we will increase greatly the margin of uncertainty for the Soviets regarding the outcome of any conventional campaign and, therefore, restore the deterrent posture of our conventional forces.

Airland battle is already being implemented with the forces and equipment now in the field.

However, the full development of the power of this concept depends critically on the completion of our modernization program, the exploitation of emerging technologies in sensors to see deep, in smart munitions to strike deep, and in data processing and telecommunications to manage these resources rapidly. Our scientific and technology base in the U.S. positions us almost uniquely to do this and, thus, to establish a major advantage over our adversaries in employing weapons on a modern battlefield.

Our plans for improving the capability of our light forces also requires an aggressive applied technology program. The reorganization of these forces under the army of excellence program will provide for greatly increased deployability. These forces, however, will need greater firepower to meet modern mechanized and armored threats, and developments in this area also require an aggressive technology program.

In summary, to meet the military challenge we have described, we must do three things: (1) Complete the acquisition program needed to modernize all units in our force, (2) exploit our advantage in science and technology to add value to that force by developing the systems needed to implement airland battle and improve the combat power of our light forces, and (3) continue our R&D to seize the opportunities our emerging technologies provide to create new capabilities and to develop greatly improved systems.

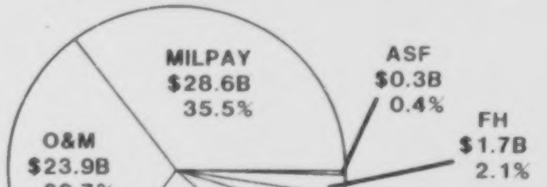
We must recognize that the fundamental advantage we have over our adversary is based on two essential ingredients: (1) The expeditious and effectively managed completion of our modernization program, and (2) the base of science and technology in the U.S. and in the NATO nations. If we do not aggressively complete our modernization while pushing our R&D programs to exploit this advantage, we will risk a serious loss in the deterrent value of our conventional forces.

Mr. PRICE. General.

## STATEMENT OF LT. GEN. LOUIS C. WAGNER, JR. USA, DEPUTY CHIEF OF STAFF FOR RESEARCH, DEVELOPMENT AND ACQUISITION, DEPARTMENT OF THE ARMY

General WAGNER. I will discuss how we put our program together, what it consists of, and I will then get into the major programs that you highlighted, so we may answer any questions you may have. If at any time you want to move to some other subject, I will be happy to do that.

FY 87 PRESIDENTS BUDGET
US ARMY - BY PROGRAM



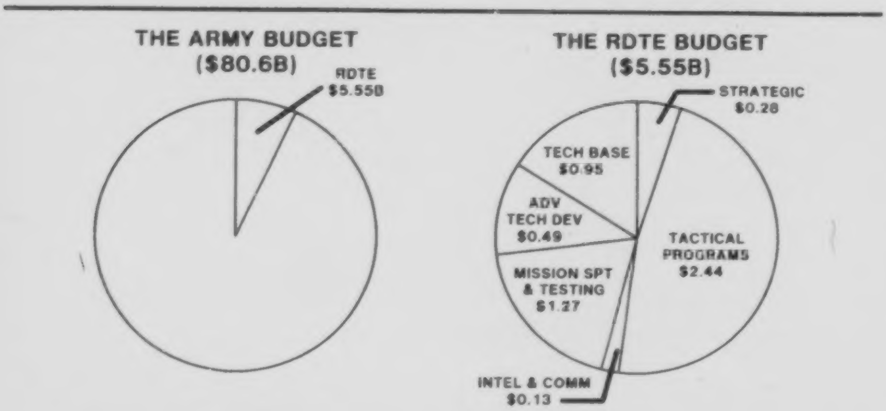
The section we are discussing is the RDT&E portion—$5.55 billion, 6.9 percent of the total military budget.

Looking at how that is broken out, 27 percent of it is in the tech base and in advanced technology development. I will cover just a few of the items we are working on there, because we have directed our efforts in the tech base so that they do have a high pay-off in later leading into the items that we want to develop. I will show you how we are doing that. For example, in our LHX program.

Mission support is not just the base operations in the R&D field, but it also includes the test ranges run not only for the military, in the Army and for the other services, and Kwajalein Missile Range.

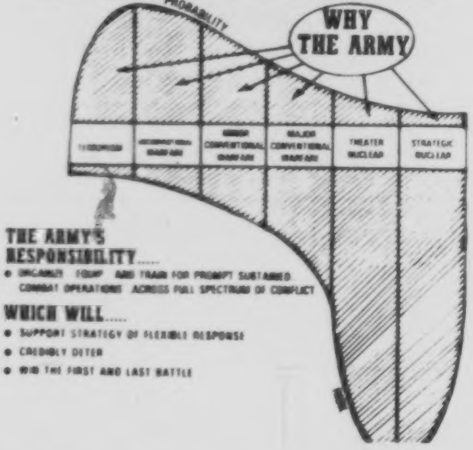
A majority of our dollars are in tactical programs. In that area are the fighting pieces of equipment that we need in the field; that is, your tank, your aircraft developments, missile developments, things of that nature.

**THE FY87 RDTE BUDGET REQUEST**



When we put together an R&D Program, just as when we put together a procurement program for the Army, we have to determine what is the proper balance and what equipment do we need to fight the many battles across the spectrum of conflict that the Army may be required to participate in.

**SPECTRUM OF CONFLICT**


PROBABILITY
WHY
THE ARMY
TERRORISM
UNCONVENTIONAL
WARFARE
MINOR
CONVENTIONAL
WARFARE
MAJOR
CONVENTIONAL
WARFARE
THEATER
NUCLEAR
STRATEGIC
NUCLEAR
THE ARMY'S
RESPONSIBILITY.....
• ORGANIZE EQUIP AND TRAIN FOR PROMPT SUSTAINED COMBAT OPERATIONS ACROSS FULL SPECTRUM OF CONFLICT
WHICH WILL.....
• SUPPORT STRATEGY OF FLEXIBLE RESPONSE
• CREDIBLY DETER
• WIN THE FIRST AND LAST BATTLE

The lowest spectrum, but the most probable, is on the terrorism side. And while we are working in that area, it is low in dollars as compared to the dollars that are on the high side where we must prepare for a major conventional war or a theater nuclear war. That is not only true in R&D where we have deficiencies, but also true in procurement.

I do want to dwell on this because you are familiar with the problem we have as far as the threat.

I do want to point out, that if you take all of the major fighting pieces of equipment we have in the NATO forces in Europe, and then take what is in the Warsaw Pact side, we are outnumbered two or three to one, whether it is tanks, artillery, or helicopters. Even if you add France in, you have very little difference in that ratio.

## PRODUCTION OF GROUND FORCES MATERIEL USSR/NSWP AND NATO*

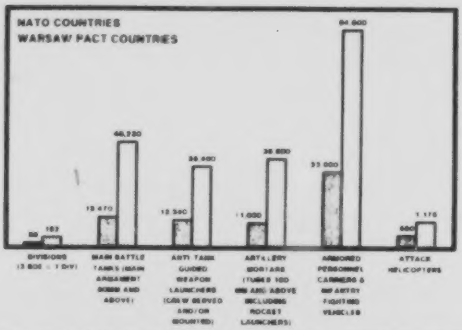
| EQUIPMENT TYPE | 1984 USSR | 1984 NSWP | 1984 NATO |
|---|---|---|---|
| TANKS | 3,200 | 450 | 1,760 |
| OTHER ARMORED FIGHTING VEHICLES | 3,800 | 1,200 | 2,230 |
| TOWED FIELD ARTILLERY | 1,600 | 250 | 425 |
| SELF-PROPELLED FIELD ARTILLERY | 1.000 | 300 | 240 |
| MULTIPLE ROCKET LAUNCHERS | 800 | 100 | 80 |
| SELF-PROPELLED AA ARTILLERY | 50 | 0 | 40 |
| TOWED AA SRTILLERY | - | 225 | 50 |

*REVISED TO REFLECT CURRENT TOTAL PRODUCTION INFORMATION.
INCLUDES UNITED STATES: EXCLUDES FRANCE AND SPAIN.
NSWP IS NON SOVIET WARSAW PACT.

For example, France has about 1,500 tanks, 5,000-plus fighting vehicles, and 170 helicopters. So it does not make a lot of difference.

More worrisome to us is the next chart, which shows that they are producing at a rate also anywhere from two to four times the rate that the NATO forces are producing. They are not only producing at that rate, but turning out a product which, in many cases, is equal in quality to that that we are producing. However, it is not all bad.

## NATO-WARSAW PACT GROUND FORCE COMPARISON (IN PLACE IN EUROPE-1984)[1]

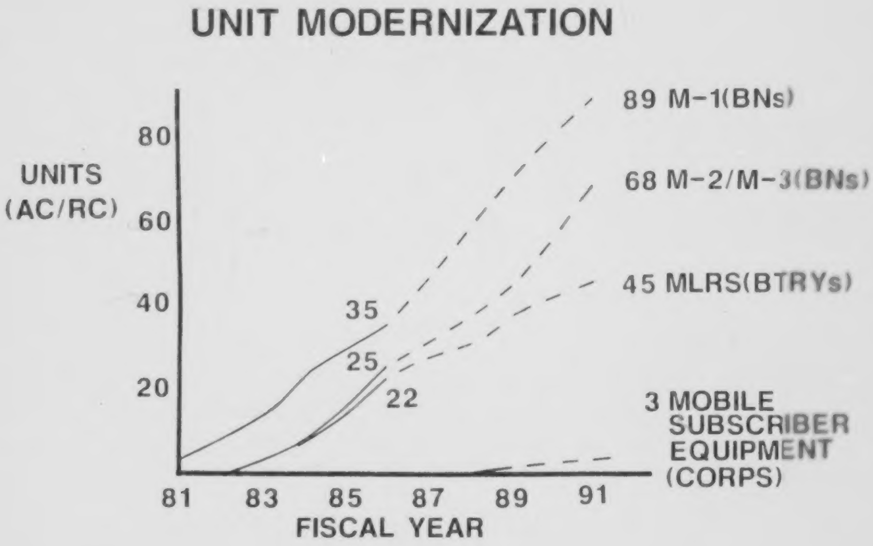


NOTES: WARSAW PACT DIVISIONS NORMALLY CONSIST OF FEWER PERSONNEL THAN MANY NATO DIVISIONS BUT CONTAIN MORE TANKS AND ARTILLERY. THEREBY OBTAINING SIMILAR COMBAT POWER.

WARSAW PACT TOTALS EXCLUDE THE 17 STRATEGIC RESERVE DIVISIONS IN THE MOSCOW, VOLGA AND URAL MILITARY DISTRICTS.

[1] EXCLUDES FRANCE AND SPAIN.

If you look at what has been happening in the U.S. Army, because of the support that we have received in this committee and in the procurement committee, you will find that today we have a significant number of units of new equipment, such as the M-1 tank, Patriot air defense system, M-2, M-3 Bradleys, Black Hawks, AH-64 attack helicopters of which we had none in 1980.



Today, we have 35 battalions of M-1 tanks fielded. If we get the support we are asking for during the next four years, by 1991 we will have 89 M-1 battalions.

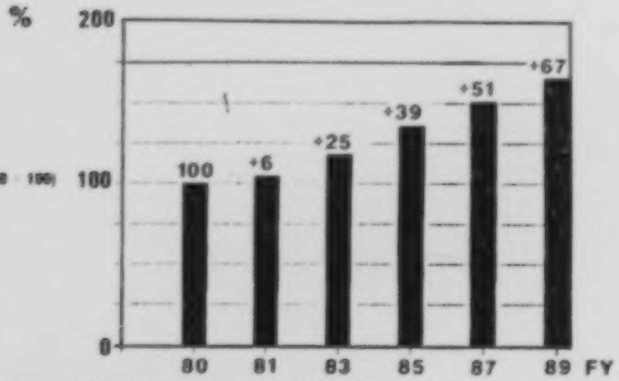
Mr. BATTISTA. General, this story is not new. I have been up here—this is my 13th year, and this is the 13th year that we have heard we are quantitatively behind and getting better; and yet, we go out in the field—Mr. Dickinson, Mr. Leath, Mr. Hefner, and myself were out to the European Command 3 weeks ago, and we asked in 1986, now, how much better off are we than we were in 1980, 1981. I can remember General Rogers telling us he had to employ a trip wire strategy, and after [deleted] sustainability, we run out, [deleted].

Trip wire strategy is still in effect, we just found out 3 weeks ago. This tells me the strategy we have been employing is not the right one. We have got to change our way of doing business.

Are we going to do that starting this year, because after 5 years of modernization we are no better off today than we were 5 years ago?

General WAGNER. The next chart will answer that, to some extent.

I disagree with those who say we are not better today than we were in 1980.



TOTAL ARMY
MILITARY CAPABILITY IMPROVEMENTS

MAJOR COMBAT UNITS (DIVISIONS, SEPARATE BRIGADES, ARMORED CAVALRY REGIMENTS)

This chart points out to you what we have found out in wargaming about the capability of our divisions, our separate brigades, and out armored cavalry regiment. Capabilities are measured at various time periods with what we think the enemy threat can throw against them.

Today—in 1985 you could take our entire Army, to include reserve components—we have 39 percent greater capability against the threat than we did in 1980. With what we have asked for, in procurement in 1987, which is going to be delivered in 1989, we will be up at about a 67-percent increase in capability over which we had in 1980. As long as the threat numbers are two to one, it is still difficult to overcome.

I am going to show you some of the systems that we are putting in R&D that will help us overcome that ratio. In the fighting systems that we are fielding today, we have significantly increased our capabilities.

Mr. BATTISTA. That is what the generals told us 3 weeks ago. And, frankly, we look at the bottom line—37 percent better, 67, whatever the numbers are.

What is important is the bottom line, and if after [deleted] regardless of the intermediate numbers, we are still in a bad situation. And in that context, they were stating that we are no better off today than we were 5 years ago.

So, please don't misunderstand. That is not my assessment. That is theirs.

General WAGNER. There have been significant increases in the war reserves in that period, and in the ammunition stocks during that period, and a great modernization of equipment—not at the rate we would have preferred, but no question there has been an increase in capability.

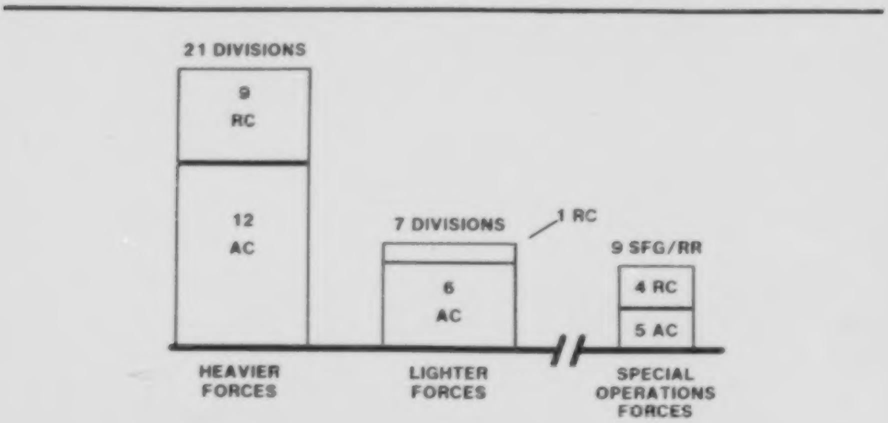
One of the greatest deficiencies is the capability to strike in the second echelon. We have a program to help General Rogers along. There are deficiencies. And unless we could have many more dollars, we can't overcome them in 3 years, or 5 years. The Soviets are willing to spend 15 percent of their gross national product. We are working at about 6 percent.

At what rate do we want to spend? We know if you go to the field and ask them, they will always say they want more.

Mr. BATTISTA. Do you agree with the bottom line assessment; that is, after [deleted] we only have those two options?

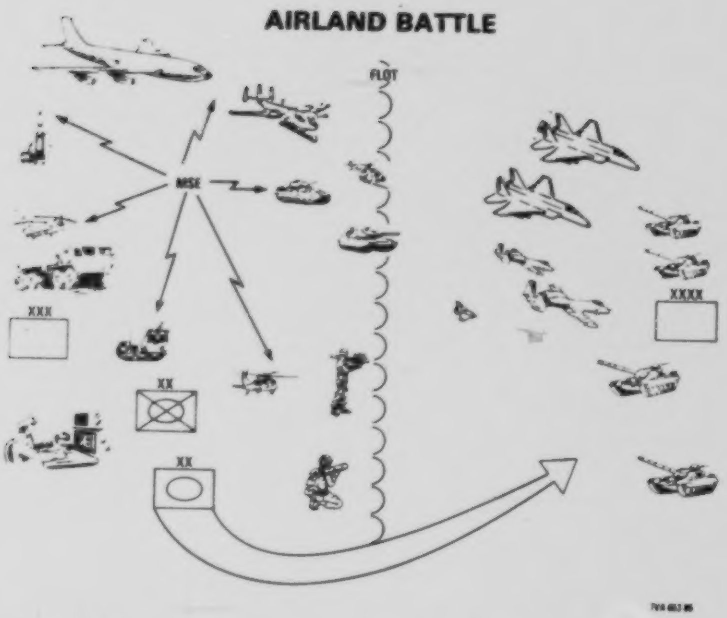
General WAGNER. I am not going to argue with General Rogers. I personally do not believe that it would escalate that quickly. But you better ask the Chief of Staff of the Army if he agrees with that one, Mr. Battista. I am not really in a position to answer that question.

Next chart.



COMPOSITION OF THE TOTAL ARMY

This is the force that we have to modernize, and we have to look at. It is weighted on the heavy side because that is the war in central Europe. In order to be able to fight contingency conflicts, we have reorganized in our lighter divisions to give them more deployability and capability. Those forces also do have an important part to play in a high-intensity warfare.



When we really look at what we should work on in R&D and what we should procure, we have to understand what our doctrine is. That doctrine is something we call air-land battle. The reason we call it that is because the Army can normally never fight alone. It must fight as a member of a team, whether it is jointly with other U.S. forces or with our coalition partners, as we would have in a NATO war.

### AIR-LAND BATTLE

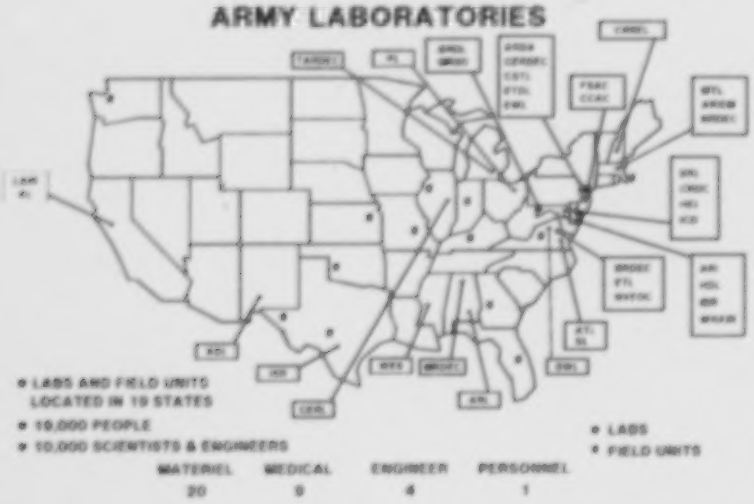
A lot of people think that in an air-land battle where you speak of the deep battle which may be [deleted] to the front of the front lines, the front lines and the rear, consists of three separate battles. You do not. They are a continuum, and are tied together. The corps commander fights those three parts of battle simultaneously.

If you had to look at a single area we are deficient today, it is the capability of fighting the deep battle. We do not have the systems to strike that enemy out there today, so we depend on the U.S. Air Force. We do not have the capability of finding him, but we have a program to correct that is called JSTARS that we are working with the Air Force today. It is a joint program to find out what the enemy is doing.

However, even if we find him, we have to be able to utilize that data in an intelligence system so the commander can make the decision to fire the lethal missile system. The Joint Tactical Fusion Program is progressing today to solve that battle deficiency.

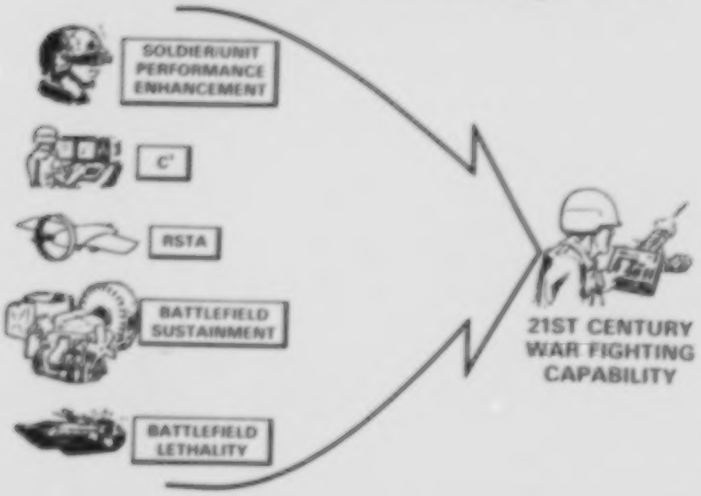
What does all this mean. There is no way you win the war out there. A lot of people would like to believe you can destroy the enemy at [deleted] and that is the end of the war. We don't think that is possible. If you win the final battle, it will be right here at the front lines. However you can effect the enemy timetable so you can handle him when he gets to the front line. The final battle is going to be right there [points to front line on chart] with your infantry, tanks, support equipment, such as engineers, helicopters, et cetera. However, they can't fight the battle unless they have proper support in the rear, and we have some programs to correct that situation.

RESEARCH AND DEVELOPMENT


ARMY LABORATORIES
● LABS AND FIELD UNITS LOCATED IN 19 STATES
● 19,000 PEOPLE
● 10,000 SCIENTISTS & ENGINEERS
MATERIEL 20
MEDICAL 9
ENGINEER 4
PERSONNEL 1
● LABS
● FIELD UNITS

What do we work with in the Army in putting our programs together? **In our technological base we have 34 laboratories and re**search, development and engineering centers, 20 on the material side, 9 medical, 4 engineer and 1 in personnel. About 60 percent of the dollars that we give them are spent out of house. About 40 percent or less are spent in-house.

## KEY OPERATIONAL CAPABILITIES


SOLDIER/UNIT PERFORMANCE ENHANCEMENT
$C^3$
RSTA
BATTLEFIELD SUSTAINMENT
BATTLEFIELD LETHALITY
21ST CENTURY WAR FIGHTING CAPABILITY

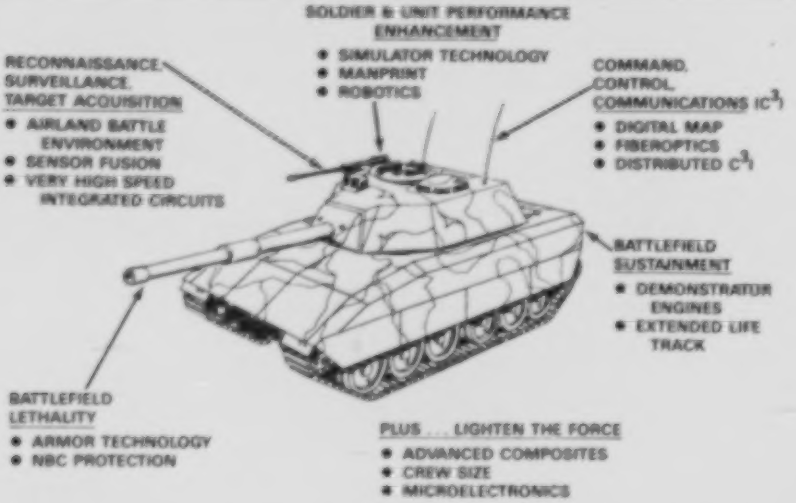
However, the labs are our smart buyers in most cases who know where to go to in industry to get a job done if they can't do it inhouse. If we are going to give them the job to do, we have to tell them the capabilities we want in the Army. The Army in the last year has said, we have to improve in these areas: soldier performance; command, control and communications; reconnaissance, surveillance and target acquisition, battlefield sustainment; and battlefield lethality.

We can apply all of these concepts to any piece of equipment we want to develop. For example, if you look at some future fighting vehicle, that looks like a tank; but it could be a helicopter or anything else, but we have to consider all of those aspects when we start working in the technology base to develop technology for one of these systems in the future.

For example, we have to look at what sensors do we want on a future vehicle or helicopter. How do we make it more lethal with whatever the killing system is? How do we make it lighter? By the use of composites, for example? What do we do about its propulsion?

Finally, we have to look at command and control and communications. It makes no difference whether it is a tracked vehicle, a helicopter or whatever it happens to be.

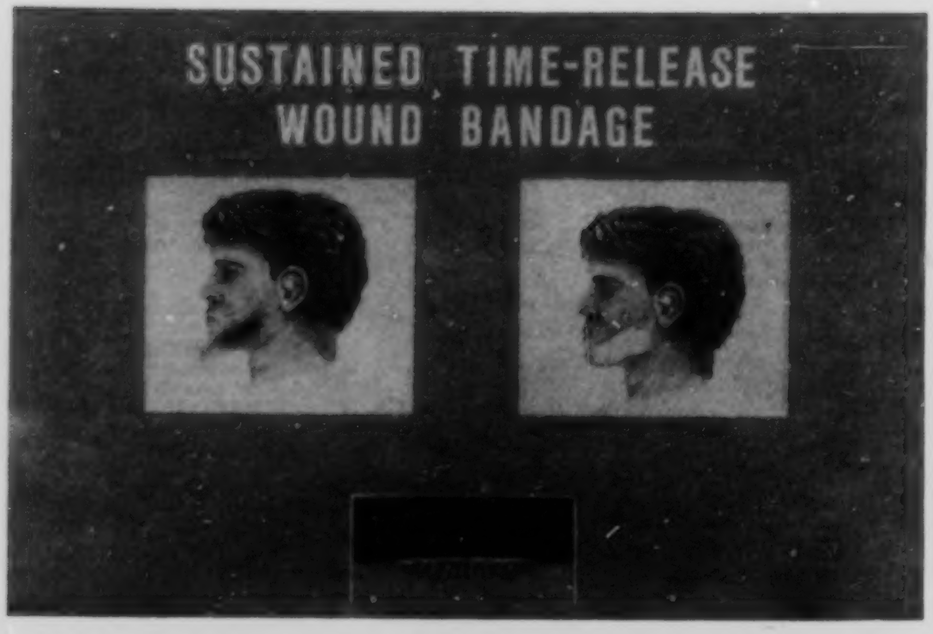
## TECHNOLOGY FOR KEY OPERATIONAL CAPABILITIES


SOLDIER & UNIT PERFORMANCE ENHANCEMENT
• SIMULATOR TECHNOLOGY
• MANPRINT
• ROBOTICS
RECONNAISSANCE, SURVEILLANCE, TARGET ACQUISITION
• AIRLAND BATTLE ENVIRONMENT
• SENSOR FUSION
• VERY HIGH SPEED INTEGRATED CIRCUITS
COMMAND, CONTROL, COMMUNICATIONS (C³)
• DIGITAL MAP
• FIBEROPTICS
• DISTRIBUTED C³)
BATTLEFIELD SUSTAINMENT
• DEMONSTRATOR ENGINES
• EXTENDED LIFE TRACK
BATTLEFIELD LETHALITY
• ARMOR TECHNOLOGY
• NBC PROTECTION
PLUS . . . LIGHTEN THE FORCE
• ADVANCED COMPOSITES
• CREW SIZE
• MICROELECTRONICS

This, for example, is a test bed for a future land vehicle. It looks like a tank, but that is not what it was designed for. What this vehicle was designed for was to put various modules in it to determine exactly what the size of the crew should be.

Then we put fire control equipment on it to see how a crewman can operate inside a vehicle like that and do his job better.

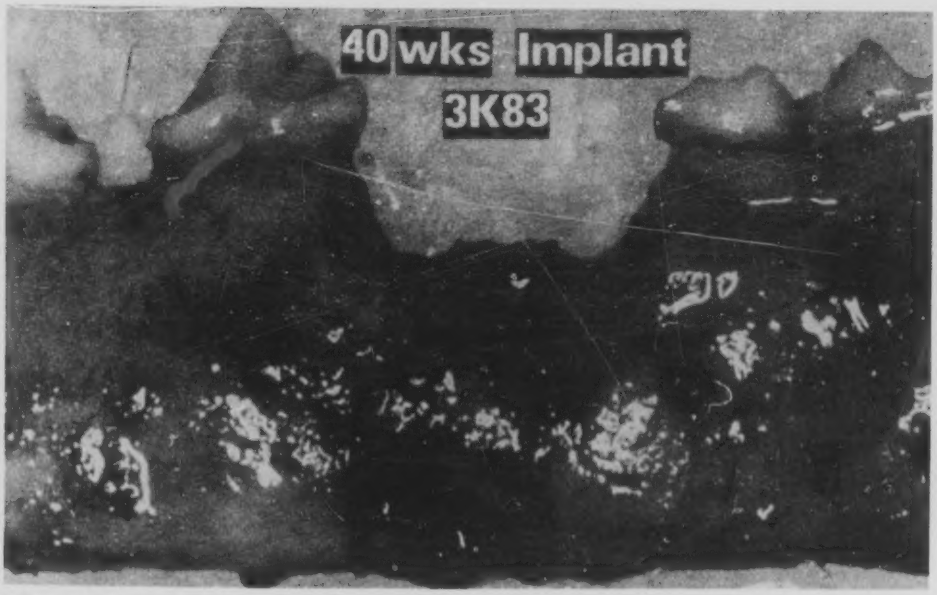
If you look at our towed 155-millimeter Howitzer today, it weighs 16,000 pounds. We had no technology to lighten that up when it was designed. Today, however, we are building one out of composites, and we believe we can lighten it up to about 9,000 pounds.



SUSTAINED TIME-RELEASE WOUND BANDAGE

[redacted]

Today, if a soldier is wounded on the battlefield, he has to have a bandage put on him and has to be treated to prevent infection. This is a new pad that we can put against a wound. It is treated with various drugs that can be released over 3 to 6 days. So, a soldier can treat himself with that. And then after a period of 3 to 6 days when he gets to the doctor, he will not have infection in his wound. It has direct application to the civilian world.



This is not a very pretty picture. It is a jaw that has been blown away. If there is a single wound that is difficult to treat, it is a jawbone wound, because it takes so long for that bone to reconstruct. What we have worked on is biodegradable bone. We can put that in the jaw today; don't have to take the bone out of the hip and go through anything from 6 months to a year while that bone slowly grows back into the face of a man for the bone structure.

This allows the bone to grow into the material and degrades slowly as the bone moves across. It will have a big payoff, particularly in facial wounds. About 18 percent of the wounds that soldiers sustain in combat are in the facial areas. It is higher than that among tankers, but that is the average across the board.

### NIGHT FIGHTING

If there is a single capability where we have an advantage over the enemy, it is to fight at night—to fight at night with night vision equipment. We had image intensification equipment in Vietnam. You had to have moonlight or starlight to help you out. With the IR capability we have today in forward-looking infrared, we can solve that problem so the soldier can see at night under nearly all conditions.

SHORT RANGE THERMAL SIGHT (SRTS) MOUNTED ON M16

We are developing a 4-pound thermal night sight that we will be able to put on an M-16A2 rifle, on our squad automatic weapon system, or something of that nature. This is a mockup of it. We have three contractors working on it right now. This will have a 6- to 8-hour capability on the battlefield and allow the soldier to engage targets up to about 400 meters.

Mr. McCurdy. What will it cost?

General Wagner. About $6,500. The image intensification binoculars cost about $7,000 2 years ago. That doesn't mean we are going to buy one for every soldier, but we expect to have two of these per squad.

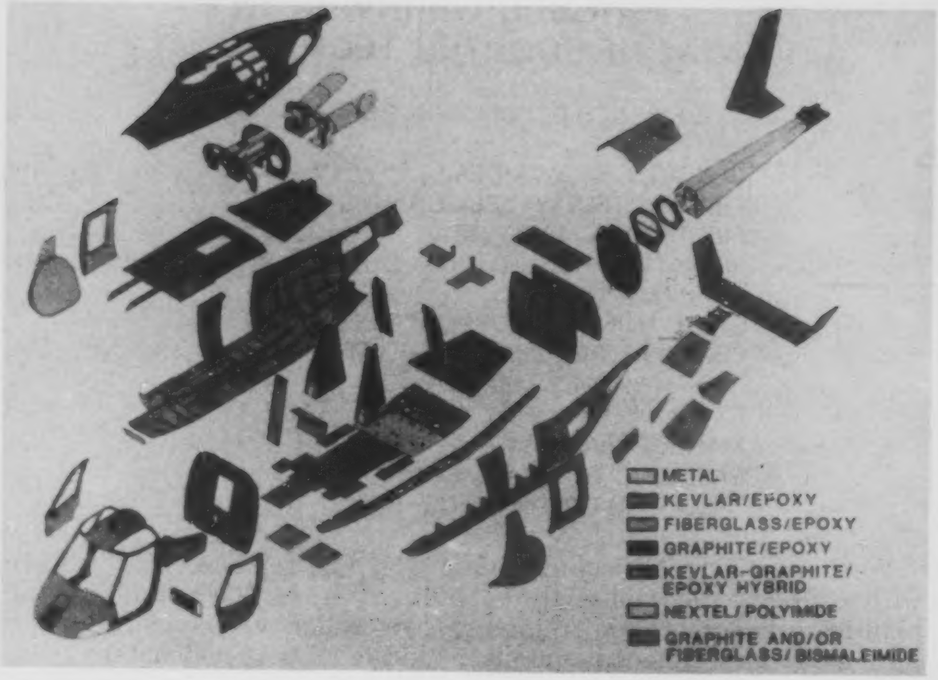
## AVIONICS

The next area is something we are doing in the aviation arena. If you went out and tore apart a Black Hawk today, you would find there are about 192 of these bell cranks in it, which are connected to cables and work on pulleys.

## SHOULD WE INVEST IN NEW HELICOPTER TECHNOLOGY?

- IMPROVEMENTS BEYOND AH64/UH60/AHIP
  - COMPOSITES VS METAL & RIVETS
  - FIBER OPTICS VS BELL CRANKS, CABLES, MECHANICAL LINKAGE
  - SIGNATURE REDUCTION (−DB) AND IR, ACOUSTIC SUPPRESSION
  - OPERATION AND SUPPORT REDUCTION
  - FIRE CONTROL SYSTEM — INTEGRATED AUTOMATION VS MANUAL
  - EXPANDED FLIGHT ENVELOPE — AGILITY & MANEUVERABILITY
  - BALLISTIC TOLERANT COMPONENTS
  - ON BOARD DIAGNOSTICS

We now have a helicopter flying that has replaced 192 of these with 6 fiber optic cables; fly by light. It saves 400 pounds in the helicopter and gives you tremendous redundancy. You can put in a number of these, shoot them out, and still fly that helicopter.


METAL
KEVLAR/EPOXY
FIBERGLASS/EPOXY
GRAPHITE/EPOXY
KEVLAR-GRAPHITE/ EPOXY HYBRID
NEXTEL/POLYIMIDE
GRAPHITE AND/OR FIBERGLASS/BISMALEIMIDE

Also, in the aviation arena, we have a helicopter flying today that is essentially all composite construction. On this particular diagram, the gray areas are metal. Some of the connectors are metal, but the helicopter is made up of various composites, Kevlar, epoxy and fiberglass. It saves 22 percent in weight and 17 percent in costs. It is more survivable in combat.

This can have a high payoff in the future, and that is one of the reasons we are looking at the development of the light helicopter family that I am going to talk a little bit about later.

Mr. McCurdy. Does it drive the costs down, or why is it cheaper?

General Wagner. It is cheaper in several ways. Today helicopters are built with rivets and sheet metal, and it is manpower intensive to build them. It is much quicker to build them in this particular manner.

The raw materials are probably not much cheaper, but the tremendous amount of time saved in construction saves dollars. It has a low O&S—operation and support—cost, because you can repair it much easier.

Mr. McCurdy. Patch it, or what?

General Wagner. You just patch it; right. Similar to the way you patch a boat that is made out of fiberglass.

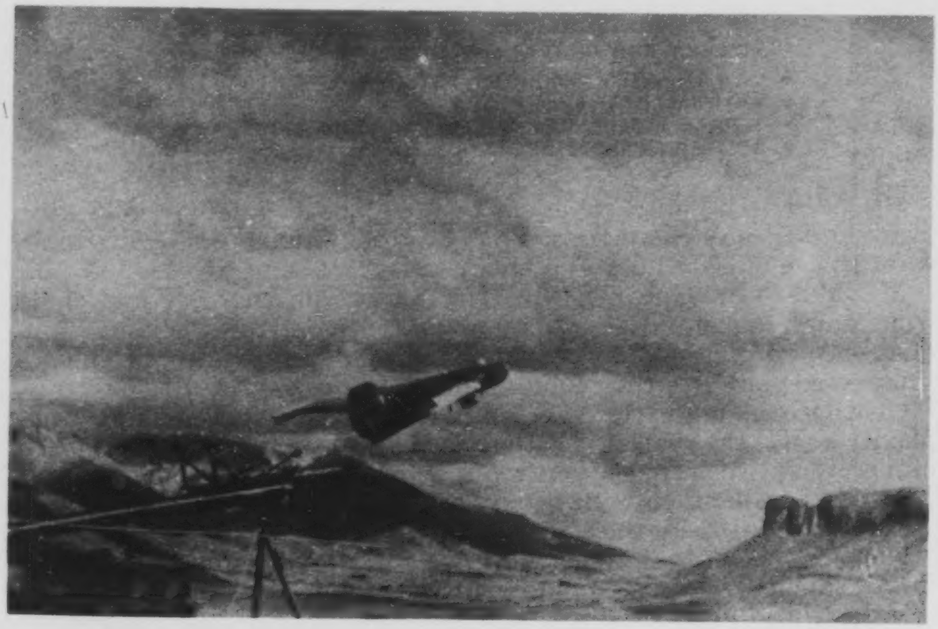
Dr. Sculley. There are currently 40,000 rivets in each helicopter.

General Wagner. The technology base is the heart and soul of what we want to do in the future, and if we manage it correctly we will have the technology we need to build things cheaper and more durable and more survivable for the individual.

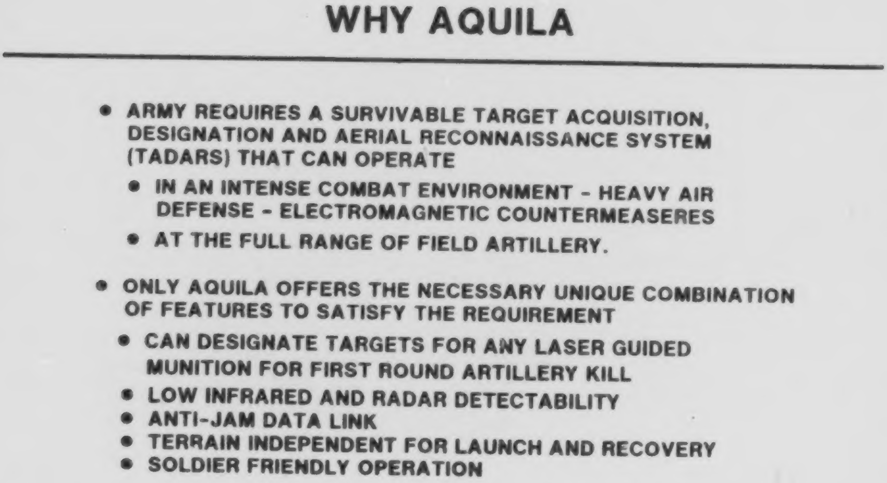
I want to look at some of our key programs, discuss those programs with you, and then answer your questions, because these are the ones that will be of most interest to you as you are marking up our budget during the next year.

### AQUILA

A program we discussed in great detail last year, the Aquila, is a 13-foot wing-span remotely piloted vehicle. I will tell you right up front that this is one program that has had a very spotty development background.



The Army never anticipated the complexity of building a system of this nature. Not only that, I don't think industry understood the complexity of building a system of this nature either, so we ran into many problems along the way. This chart lays out why we need Aquila.



## WHY AQUILA

- ARMY REQUIRES A SURVIVABLE TARGET ACQUISITION, DESIGNATION AND AERIAL RECONNAISSANCE SYSTEM (TADARS) THAT CAN OPERATE
  - IN AN INTENSE COMBAT ENVIRONMENT - HEAVY AIR DEFENSE - ELECTROMAGNETIC COUNTERMEASERES
  - AT THE FULL RANGE OF FIELD ARTILLERY.
- ONLY AQUILA OFFERS THE NECESSARY UNIQUE COMBINATION OF FEATURES TO SATISFY THE REQUIREMENT
  - CAN DESIGNATE TARGETS FOR ANY LASER GUIDED MUNITION FOR FIRST ROUND ARTILLERY KILL
  - LOW INFRARED AND RADAR DETECTABILITY
  - ANTI-JAM DATA LINK
  - TERRAIN INDEPENDENT FOR LAUNCH AND RECOVERY
  - SOLDIER FRIENDLY OPERATION

We need it because we have to have the capability of looking over the hill anywhere from 15 to 20 to 30 kilometers away. If we want to use our artillery effectively today, we send two———

Mr. McCurdy. General, can I interrupt you there? I just came from another committee where we heard from the Packard Commission, and one of their recommendations is in the requirements process, so you have the requirements here.

On the one hand, you say industry didn't understand the complexity, and the basic question is: Were the requirements too much? Were we trying to put too much into this little bird here, or trying to do too much with it too soon?

Isn't that basically the underlying problem?

General Wagner. I don't think we were trying to put too much into it. Maybe we put too many restrictions on it as far as size and so forth initially. If we had allowed it to grow bigger in the earlier phases, we might have been better off.

We have now proven we can build it smaller, but it has been long and tough to be able to do that, and as a result we have run into a lot of problems along the way. But we need a capability to accurately locate the enemy, and to do that you can't do it unless you have a laser range-finder so you can find his exact location and fire for effect with artillery on the first round.

Mr. McCurdy. I cite one personal experience. The chairman of the committee came to my district at Fort Sill, and they were going to have a demonstration of Aquila with Copperhead, and it didn't work. So we had to shoot the MLRS in-between until they could finally target it. And we came back—perfectly clear, sunny day in Oklahoma, as they usually are, stationary target, and it took about 2 hours to finally get this thing, a lock on it, in order to stay, in order to make the shot.

I can understand that, but it is rather embarrassing when you have the chairman of the full committee out there in your district for this demonstration. And that is one example of some of the problems we have had.

Dr. SCULLEY. General Wagner pointed out that we in the Army are not pleased or proud of the development history in the Aquila Program. Hindsight tells me that from the beginning a family approach would have been the more prudent approach to solving a spectrum of problems in this area.

I think since the chairman had the opportunity to be at Fort Sill, there have been some significant events that General Wagner will address.

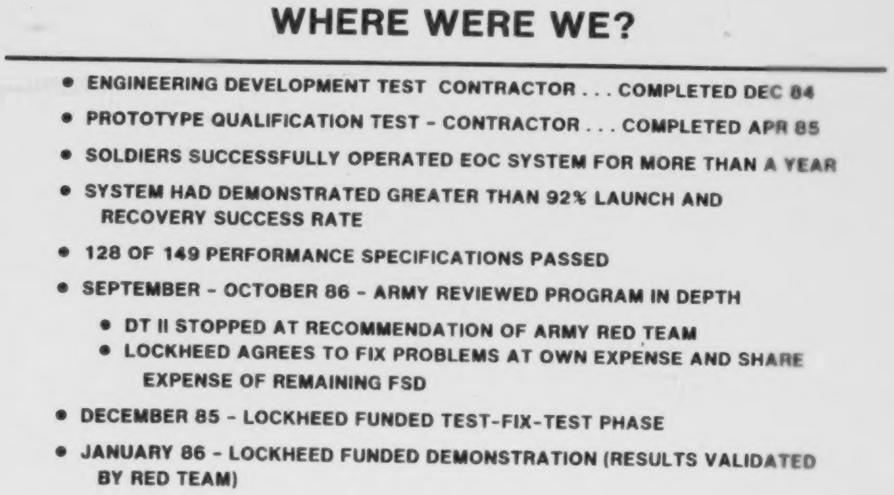
I also think that my report to the chairman of January 31, this year, classified at the secret level, does in fact lay out an approach that to me makes a considerable amount of sense.

Mr. MCCURDY. How much more R&D money do we need?

General WAGNER. From fiscal year 1986 through completion we require about $276 million; $623 million sunk to date.

Last year, we said it would take $1.044 billion to finish it. We have reduced the required program now to $890 million.

We have decided that we are not going to put any more packages on it. It will have a daylight capability and a FLIR to give it night/adverse weather capability. We made this decision after a long look at where we are going.



## WHERE WERE WE?

- ENGINEERING DEVELOPMENT TEST CONTRACTOR . . . COMPLETED DEC 84
- PROTOTYPE QUALIFICATION TEST - CONTRACTOR . . . COMPLETED APR 85
- SOLDIERS SUCCESSFULLY OPERATED EOC SYSTEM FOR MORE THAN A YEAR
- SYSTEM HAD DEMONSTRATED GREATER THAN 92% LAUNCH AND RECOVERY SUCCESS RATE
- 128 OF 149 PERFORMANCE SPECIFICATIONS PASSED
- SEPTEMBER - OCTOBER 86 - ARMY REVIEWED PROGRAM IN DEPTH
  - DT II STOPPED AT RECOMMENDATION OF ARMY RED TEAM
  - LOCKHEED AGREES TO FIX PROBLEMS AT OWN EXPENSE AND SHARE EXPENSE OF REMAINING FSD
- DECEMBER 85 - LOCKHEED FUNDED TEST-FIX-TEST PHASE
- JANUARY 86 - LOCKHEED FUNDED DEMONSTRATION (RESULTS VALIDATED BY RED TEAM)

As we went through the year, we found that you could operate it, but we still had some real problems with it, so we created a Red Team in the Army—they were given full authority to look at everything that was going on. They were not, incidentally, from the Aquila Program but from all over the Army, and they also had some outside consultants.

We had passed 128 of the 149 performance specs, but we had a problem in being able to lock on and automatically track targets. We had some problems with recovering the air vehicle. If you can't recover it consistently without a lot of training, you are not going to be able to save an expensive piece of machinery, not necessarily the bird itself but the sensors.

We had some problems with dead reckoning, so after this Red Team came in and briefed us. The leadership of the Army, the Vice Chief of Staff, Under Secretary of the Army, Dr. Sculley and several others of us met with the chief executives of Lockheed and said, "There are the problems we have, and we are not going any farther unless we can lick them."

They proposed—and we accepted—that they would at their own expense work on these problems, and run what they called a demonstration in January. If they proved at that time that they had solved the principal problems we ran into, then we would determine whether or not we should go ahead with the program.

## WHERE ARE WE NOW?

---

- LOCKHEED DEMONSTRATION SUCCESSFUL
  - 60 LASER DESIGNATIONS ON STATIONARY TARGETS (100%)
  - 31 LASER DESIGNATIONS ON MOVING TARGETS (100%)
  - 9 LIVE FIRE COPPERHEAD EXERCISES
    - 4 MOVING TARGET DIRECT HITS
    - 4 STATIONARY DIRECT HITS
    - 1 MUNITION FAILURE
  - 15 FLIGHTS WITH HANDOFF
  - SIMULTANEOUS CONTROL OF 2 AIR VEHICLES
  - DEAD RECKONING AND SURVEY UPDATE
  - AUTOMATIC RECOVERY (26 OF 26)

- DT II SCHEDULED TO RESUME FEBRUARY 1986

- PROGRAM RESTRUCTURED
  - FSD EXTENDED 12 MONTHS TO PROVIDE ORDERLY ACCEPTABLE RISK PROGRAM
  - CLEAR GO/NO GO DECISION POINTS EXTABLISHED

When they came back on February 11 these are the results they had achieved. These results were confirmed by the Red Team. It was conducted by Lockheed, but under the observation of the Army throughout, to see if they were meeting these requirements.

They did, for example, run 60 laser designations on stationary targets, 100 percent success; 31 laser designations on moving targets, 100 percent success; 9 live fire Copperhead exercises where they had 4 hits on stationary targets, and 4 hits on moving targets—that was one of the principal problems before; 1 Copperhead round failed.

I have a short tape here that will show you some of the firing that they did. This was done in January, Mr. McCurdy.

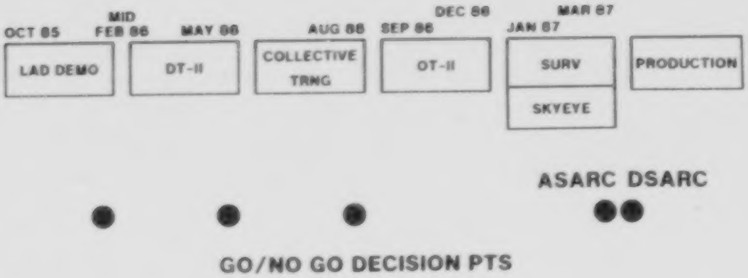
[A short film was shown.]

General WAGNER. In addition to the live firings, they flew 15 flights with hand off between ground control stations. Our concept is that it will be launched from the rear of a division area, and as it flies forward it will be handed off to a forward controller, in either a brigade or somewhere forward in the division forward area. Therefore, the launcher could conceivably have four air vehicles in the air at one time, if we had three groups forward controlling, and he was controlling his own in the rear area. We had not been able to accomplish that before successfully.

You can simultaneously control two air vehicles. You could put one in a fired-flight pattern and actively control the other with one of the ground stations. The dead reckoning worked successfully and we had automatic recovery 26 out of 26 times.

After we looked at these results based on the Red Team's recommendation, we determined that it was probably the right decision to go ahead with full-scale development and into Development Test II, which we had stopped. However, in doing that, we wanted to make sure that there were times during the continuation of the development when we could back out with minimum requirements for additional funds by the Army. This restructured program, including Lockheed's demonstration, required we extend our full-scale development 12 months.

## REVISED AQUILA PROGRAM SCHEDULE



What we have done is divided the program up into phases. Lockheed demo was our first go no-go point. If they Army had pulled out at that time, we would have had to pay a minimum for stopping the program.

Our next go no-go point is at the end of Development Test II, the end of May.

At the end of each of these periods, results will be briefed to the individuals I indicated before; and then it will go to the Chief of Staff and Secretary of the Army to determine if we continue the program.

Collective training, another go no-go point follows, and then into Operational Testing II. If we successfully get through Operational Testing II, there will be an ASARC, DSARC decision before we can go to production. We have the capability of getting out then also, if we need to.

Locheed has agreed to pick up 50 percent of the additional Aquila only costs incurred during full-scale development and not previously under contract. Total outlay for them will be about $50 million, if we continue the program to the procurement decision point.

Mr. McCurdy. What is the Skyeye?

### SKYEYE

General Wagner. We have several Skyeyes. They are in SOUTHCOM. I can't discuss what they are doing down there in open session.

We have to date procured eight of them. Six of those have crashed. They are primarily for observation.

We have taken off-the-shelf items seriously. In the 1986 budget, we have programmed unused Aquila procurement dollars to look at off-the-shelf items and supplementing this funding through reprogramming, with an additional $9.9 million, for a total of $21.5 million.

We will look at off-the-shelf items for missions other than high intensity items. We would not need an air vehicle as sophisticated as Aquila for low-intensity conflict.

We will be flying Skyeye and Aquila in survivability test in January of 1987. We would have flown that sooner, but we didn't have a Skyeye to fly. We will measure radar cross sections, et cetera, and shoot at it to see if you can lock on either one with air defense weapons.

Mr. McCurdy. What RPV's are available from other countries? Is there anything that can come close to what you are talking about here?

### OTHER RPV'S

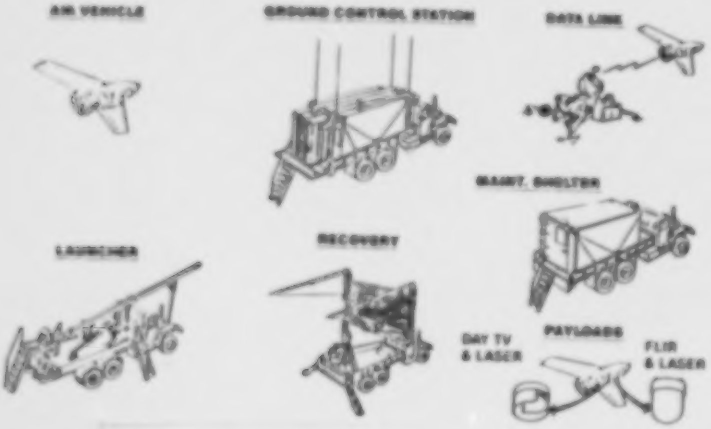
General Wagner. There are other RPV's available today, however, their ability to accurately locate targets for getting first round hits with artillery, and so forth, has yet to be demonstrated—also, they do not at this time have an antijam data link, and because of the configuration may or may not be as survivable.

Mr. McCurdy. How much ground equipment is required to support Aquila?

### AQUILA GROUND EQUIPMENT

General Wagner. Give me the backup chart showing the ground equipment.

## AQUILA SYSTEM DESCRIPTION



It consists of a launcher, which is a rail, a net, a ground control station which has the data link to it. There are trucks that haul the aircraft around, and also a maintenance vehicle. Then there are headquarters and operational support vehicles.

Mr. McCurdy. How many is that? Five?

General Wagner. About eight trucks in the launch area.

[The following information was received for the record:]

### RPV Program Details

Each central launch and recovery station (CLRS) is supported by seven vehicles. A truck is provided for the launcher, the recovery net, the ground control station, the air vehicle handler and for the section commander. Two cargo trucks are provided to haul air vehicles and pull generators. There are two CLRS's per battery. In each forward control station (FCS) there are three vehicles, one for the section commander, one for the ground control station and a cargo truck to pull a generator. There are three FCS's per battery. The operational concept is to launch air vehicles from a CLRS in a Division rear area and hand them off to the FCS located forward with the Brigades. The FCS's then control the air vehicles beyond the forward line of troops, perform the directed mission, and return the air vehicles for handoff back to the CLRS and recovery. The vehicles in the CLRS's and FCS's total 23. In addition, there are 9 vehicles dedicated to the battery for command and control and maintenance support bringing the total number of trucks per battery to 32.

If you ask me the total cost of the program, today in procurement, the desired program is somewhere around $1 billion. However, what we are looking at is a way of reducing this by looking at for example, how many FLIR's we need; do we need for every RPV a separate FLIR or so many per battery. So, we think that cost will probably go down somewhat, and put the total program well under $2 billion.

Mr. Battista. Are you saying there is a total of only eight vehicles now?

General Wagner. Up to eight in a launch area. I've got to look at it.

Mr. Battista. The development cost was $1.3 billion.

General Wagner. No. Development was $1.044, which is what we reported to you last year.

Mr. **Battista**. Last year, you asked for about $13 million in R&D to finish the program. And one more year after that, this year, my information is that you are going to need approximately $100 million to $150 million more to finish the development.

General **Wagner**. The program last year went on through fiscal year 1990, because it had other follow-on missions for the bird, and that is one reason the total program was $1.044 billion.

The Army had other packages they wanted. There were people that wanted EW packages and a lot of things. They were still carried in the program when we were over here last year.

Mr. **Battista**. In terms of the budget, you had requested only $13 million plus or minus last year for R&D. Now I understand you need between $100 million and $150 million within the next 12 to 18 months to complete the program to the point where you were going to be without the additional packages?

General **Wagner**. Our program last year, in 1986, was $35 million engineering development funding. Engineering development funding was short of the fiscal year 1986 fiscal year 1986 requirement at that time by about $25 million.

Mr. **Battista**. In research and development?

General **Wagner**. That is right.

Mr. **Battista**. You must have had a lot of money buried.

General **Wagner**. That includes MICNS, because MICNS is a part of it.

I have got the details, and I will provide them to you.

[The following information was received for the record:]

### RPV Program Details

I would like to point out, first, that the FY 1986 budget did not reflect the actual FY 1986 requirement. An ASARC level review in December 1984 established the FY 1986 requirement at $60.1 million. This total included $29.4 million for the basic Aquila day system development, $25.7 million for FLIR night payload development, and $5.0 million for testing and operation of a prototype early operational capability (EOC) system. The FY 1986 budget of $35 million only provided $6.9 million for the Aquila day system, $23.1 million for the FLIR and $5.0 million for the MICNS data link. These requirements were predicated on development of the basic Aquila system being completed in FY 1986.

Because of problems encountered during Development Test II, the Army restructured the program in September 1985, extending it about one year. As a result of this restructing the FY 1986 RDTE funding requirement increased from $60.1 million to $86.3 million. The FLIR development requirement decreased from $25.7 million to $19.6 million since some work had to be deferred and the EOC cost of $5 million was eliminated. On the other hand, the MICNS estimate increased to $5.5 million and basic Aquila requirements increased from $29.4 million to $61.2 million. The direct cost development testing and collective training for operational test II is estimated to be $32 million which will be shared by the government and the contractor. The government share is $16 million which is distributed among the program elements. The Aquila increase of $31.8 million may be broken down as follows:

| Purpose: | *Millions* |
|---|---|
| MICNS support to development test (DT) II | $6.4 |
| Modifications for new O&O concept | 2.7 |
| Survivability evaluations (Aquila/Skyeye) | 1.0 |
| Post DT II fixes | 4.0 |
| Test Program Set development | 1.3 |
| Other new work (additional air vehicles, pre-production development, in-house support and product assurance and management reserve) | 16.4 |
| Total | 31.8 |

The Army will be able to fund $85.4 million of the $86.3 million requirement with dollars available plus the $35.3 million reprogramming being requested of Congress.

**Mr. Battista.** Colonel Gibbons, do you have that number?

**Colonel Gibbons.** $36 million in RDT&E, just for the Aquila.

**Mr. Battista.** Do you need $100 million to $150 million to complete the program now?

**General Wagner.** The restructured RDTE Program needs about $276 million. That is not all on Aquila.

It includes the data link, the FLIR payload. That is across the board.

**Mr. Battista.** What did you estimate you needed before the $100 million or $150 million?

**General Wagner.** I will have to find that.

[The following information was received for the record:]

### RPV PROGRAM DETAILS

The ASARC level program review in December 1984 established Aquila program RDTE requirements to completion. Principal efforts included the basic Aquila day system, the FLIR mission payload system, the MICNS data link and work on Early Operational Capability systems. The cost of this program from FY 1986 to completion was estimated to be $139.6 million. This program excluded the pre-planned product improvements for range extension and additional payloads.

**Mr. McCurdy.** Let's take about a five-minute break here. I have got a vote in the Intelligence Committee, and the Chairman should be back in just a minute. Take that time and find your data, and you can have an off-the-record discussion for a few minutes.

We will try and get back over in a few minutes.

[Recess.]

**Mr. Darden.** [presiding]. We will resume.

Mr. Battista, you were in the middle of a question.

**Mr. Battista.** Yes. What it boils down to is I was looking at your descriptive summary. Your fiscal year 1986 estimate was $30.04 million. That is what your request was. Your fiscal year 1987 estimate at that time was $16.35 million, resulting in a total of roughly, let's say, that is $46.39 million.

Now your descriptive summary this year indicates that in 1986 you have to spend $73.868 and in 1987, not $16.35, but $91.880. That is very close to the number that I understand basically you have, about $100 million overrun. Now the $73 million, as I understand it, would require a reprogramming action since Congress didn't give you $30 million last year.

So my question is simply, Do you or do you not have about a $100 million overrun in the program between last fiscal year and this fiscal year?

### RPV COST

**General Wagner.** I believe it is less than $100. I am going to provide that for the record. The program, as we have structured it now, to complete the Aquila, is $153.4 million, and that includes 1986 and 1987. That is $623 million sunk and $131 million to complete the Aquila, $31.8 million for MICNS, and $86 million for the FLIR. I have to work the numbers on apples to apples basis with just Aquila backed out, because last year, if you looked at the FYDP, there were dollars in there for other things.

I want to separate those to make sure they are right. There is no question there is some increase, I believe less than $100 million.

[The following information was received for the record:]

### RPV Program Details

As I noted earlier, and ASARC level program review in December 1984 established Aquila program RDTE requirements; however, these requirements were developed too late to be incorporated into the FY 1986 President's budget. The December 1984 estimate of these requirements for FY 1986 and FY 1987 are shown below. For purposes of comparison, I've limited the tabulation to the Aquila engineering development funding line which includes the Aquila day system and FLIR night system.

| | Fiscal year— | | |
|---|---|---|---|
| | 1986 | 1987 | Total |
| Aquila[1] | 34.4 | 25.0 | 59.4 |
| FLIR | 25.7 | 22.1 | 47.8 |
| Total | 60.1 | 47.1 | 107.2 |

[1] Includes $5.0 million in FY 1986 and $4.0 million in FY 1987 for planned modifications to early operational capability systems.

Below are tabulated the portion of the FY 1986 and FY 1987 President's budgets reflecting the figures you discussed.

| | Fiscal year— | | Total |
|---|---|---|---|
| | 1986 | 1987 | |
| FY86 President's Budget: | | | |
| Aquila | 6.9 | 6.1 | 13.0 |
| FLIR | 23.1 | 10.3 | 33.4 |
| Total | 30.0 | 16.4 | 46.4 |
| FY87 President's Budget: | | | |
| Aquila | 57.8 | 51.9 | 109.7 |
| FLIR | 16.0 | 40.0 | 56.0 |
| Total | 73.8 | 91.9 | 165.7 |

As you can see, the FY 1986 President's budget total for FY 1986 and FY 1987 actually was $60.8 million short of our requirements.

The FY 1987 President's budget supports activities that were to be addressed by the December 1984 funding plus the cost of extending the program and adding new work, such as the Aquila/Skyeye survivability test. A strict comparison of this year's budget with last year's does indicate over a $100 million increase; however, comparsion between this year's budget and last year's actual requirement shows a $67.5 million increase.

Mr. **Battista**. I thought you said earlier Lockheed had agreed to put 50 percent or $50 million out of their pocket toward the additional costs.

General **Wagner**. The additional cost over what it would have been last year after we had the program laid out then in full scale development. Now, there are expenses, you understand, that we have in there over and above that for running the PM shop and that sort of thing. That is the reason it comes to a total of about $50 million.

### RPV Program Details

The total Lockheed contribution to complete the full scale development (FSD) program will be $49.3 million. In FY 1985, Lockheed paid about $8 million for testing and fixing major technical performance problems reported during development testing by the Army's Red Team. In FY 1986, the Lockheed share is $36.2 million. This includes $20.2 million covering the contractor's test-fix-test work from 1 October 1985 through the completion of the system demonstration in January 1986, and $16 million for continuation of those efforts defined in the existing FSD contract that were interrupted for deferred as a result of stopping the FSD work in FY 1985. These efforts include Development/Operational Test II, TEMPEST and other specialized testing, system qualification testing, software varification, development of maintenance plans and logistics documents.

The Lockheed share in FY 1987 will be $5.1 million.

Mr. **Battista**. OK. In any event, if I look at your two descriptive summaries from last year and this year, I add up approximately, I got about a $130 million plus increase in the 2 fiscal years.

General **Wagner**. OK. For those 2 fiscal years. I think that is probably right. And that includes—MICNS, I think, cranked into that line.

Mr. **Battista**. It is under "mission payloads", but I say in terms of the vehicle, the vehicle alone, just the Aquila last year you had estimated $6.9 million in 1986, and what you are suggesting this year is you need $57.8 million in 1986 now, requiring a reprogramming and for 1987, you had estimated $120, and that is $41.8. So that indicates $80 plus million on the Aquila alone.

General **Wagner**. That is approximately right. As I said, we need $153.4 million on Aquila under our restructured program. What we will do is break it out by each individual item and come over and show that to you, if that is OK.

[The following information was received for the record:]

I have already shown you that the FY 1986 budget did not adequately reflect our FY 1986 and FY 1987 requirements and have shown why the FY 1986 requirements increased. The FY 1987 requirements last year were $47.1 million. Of this total, $22.1 million was for FLIR development and integration, $4.0 million was for modification of an Early Operational Capability (EOC) system and $21.0 million was for Aquila and government in-house support. At the time these requirements were developed, testing of the basic Aquila day system was to be completed in FY 1986. When the program was restructured in September 1985, operational testing II (OT II) was slipped into FY 1987, the FLIR program was extended and necessary additional work was incorporated into the program.

As a result of Aquila program restructuring, the $47.1 million requirement increased to $91.9 million which is reflected in the FY 87 President's Budget. The December 1984 requirement for the basic day system, $21.0 million, was reduced to $10.9 million since planned test program set development work had to be deferred until FY 1988 and beyond. In addition, the $4.0 million EOC system modification effort was eliminated. However, the addition of new work and operational testing contributed $40.3 million to the FY 1987 requirement. The direct cost of operational testing is estimated to be $10.2 million which will be shared by the government and the contractor. The government share is $5.1 million which is distributed among the program elements. The $40.3 million is broken out as follows:

*Fiscal Year 1987*

[Dollars in millions]

| *Purpose* | *Amount* |
|---|---|
| MICNS support to operational test II | $4.6 |
| Aquila/Skyeye survivability test | 4.9 |
| Training support (PM Trade) | 3.5 |
| New organizational and operational (O&O concept test | 4.3 |
| OT II system fixes | 6.0 |
| Other new work (additional air vehicles, other government agency (OGA), support, pre-production development, producibility engineering, proposals, management reserve) | 17.0 |
| Total | 40.3 |

The FLIR effort was restructured to accommodate the basic Aquila system schedule stretch and to correct a FLIR payload/AQUILA system interface problem resulting from changes made to the basic Aquila system in FY 1985. These two factors caused the FY 1987 FLIR cost to increase $18.6 million over the old requirement of $22.1 million to a total of $40.7 million. The sum of $10.9 million for the basic day system, $40.3 million for new work and $40.7 for FLIR work totals $91.9 million.

Mr. DARDEN. Pardon me for being here late. I was chairing the meeting of another subcommittee next door. I apologize for the interruption we had. We appreciate your being here. We always look forward to it. I happened to come right in the middle of a subject which is near and dear to my heart.

How many RPV programs, DOD programs, do we have currently in the Department of Defense?

General WAGNER. We are looking at a family right now. The Aquila will be our short-range program, and possibly there might even be a cheaper short-range program for units that would be in low-intensity warfare.

We are looking at a program to buy some off the shelf. It wouldn't have to have the laser designation for Copperhead and so forth. We will be going out with a RFP to bring in some of these.

Mr. DARDEN. Which would be the one off the shelf?

General WAGNER. The one off-the-shelf that we are looking at right now would be medium range one. We have $21.9 million we are going to use in procurement in 1986 for that.

Mr. DARDEN. Which one is that?

General WAGNER. We don't know what it is going to be, sir. We are going to go out with a RFP. There are foreign and U.S. manufacturers of those. It will be part of the family, for use as a corps level intelligence/electronic warfare system.

There is also another member of the family that was in the study that was sent over here. We are looking at off-the-shelf versions of that, and we are looking at a Navy development program in a joint sense, because that particular capability is needed by several of the services.

Mr. DARDEN. I didn't mean to come in here at this particular juncture and try to make a statement, but it seems like it is somewhat coincidental. This is something we keep on harping on, about trying to have some commonality in programs.

Dr. Sculley, do you know how many we have going on right now, how many RPV programs in DOD there are?

Dr. SCULLEY. I know specifically of four.

Mr. DARDEN. Could it be as high as 12?

Dr. SCULLEY. It could very well be, but there again I think there clearly are programs in existence I am not aware of.

Mr. DARDEN. Mr. Battista, could you address that?

Mr. BATTISTA. Yes, sir.

There are at least three in another community in DOD. There are three in the Navy, two in the Army, and if you include other areas, there are at least 12 that I can think of right now.

General WAGNER. If you count other areas, I am sure——

Mr. BATTISTA. Other areas in DOD.

General WAGNER. And for other purposes, too.

Mr. BATTISTA. I am counting them just for military purposes.

General **Wagner**. I understand that. I am talking about for observation, control of fire, things of that nature. We can't discuss the details of some in open session.

Mr. **Battista**. There is more than four.

General **Wagner**. Yes, sir. No question. There are at least four types of families, but within those, there are more than that. There is no question.

Mr. **Darden**. Four different families. And, of course, families are of varying sizes.

Mr. **Battista**. At least a dozen discrete RPV's that are in existence.

General **Wagner**. This is the only RPV of this particular sort, though, today that can direct artillery fire and has the laser designation capability for the Copperheads and the other SMART munitions, such as Hellfire and laser-guided bombs. There is no other one today that is available for fielding. That is not to say you couldn't take those packages and put them on something else if you took the time to do it.

Mr. **Battista**. Let me respectfully disagree with you. We did what you had on your TV video there in 1973, with a priority—it was a $1,000 model airplane—and we hit both stationary and moving targets.

General **Wagner**. I don't disagree with you. I am talking about what is available for production today. Yes, I can put one together and do that, there is no question.

Mr. **Battista**. You can even produce it.

General **Wagner**. You can produce it—but you are going to have to do some work to it before you go into production.

Mr. **Battista**. Depending on how you review your requirement.

General **Wagner**. Right.

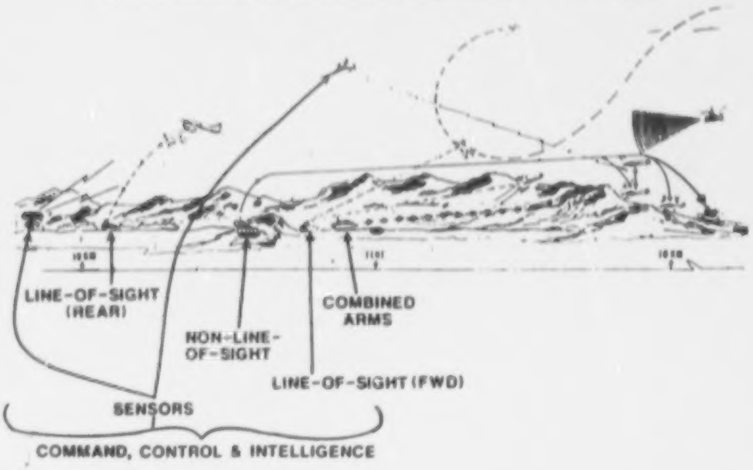
Mr. **Darden**. Please proceed.

General **Wagner**. Do you have any more questions on Aquila or RPV's?

Mr. **Darden**. No further ones. Thank you.

General **Wagner**. One of the areas you said you wanted to discuss today was where are we going in our forward area air defense after the Sergeant York Program was stopped last year?

FORWARD AREA AIR DEFENSE SYSTEM



Would you give me that next slide. When we looked at the forward area air defense in the past, we looked at it as a series of discrete weapons, and that was not very smart because fighting an air battle takes a combination of all the weapons on a battlefield. If the loss of the Sergeant York did nothing else for us, it put a lot of pressure on looking at how is it best to fight that air battle. I don't think until we ran the Sergeant York test we really realized how difficult it is to cope with the hovering helicopter particularly, and that is one of the most difficult threats to deal with.

When we looked at the problem, we found it takes a combined arms effort to do the job. You have got to use your vehicles on the ground, such as your tanks, that can engage those helicopters. With the proper munitions, you can probably be fairly effective against a helicopter if you can get him within the range of the tank gun. With some of the munitions you can probably get out there to 3,000 meters or so if you can acquire the target.

However, the real problem we have is how do we take care of that hovering helicopter when he is out there at a standoff distance of maybe 5 to 10 kilometers beyond the front, and how can we attack him at that place? Our studies and analysis have shown we really need a non-line-of-sight capability to go after him. We believe that is available. There are several ways we may go.

You can probably use a ground launched AMRAAM, although I will show you something called FOG-M or fiber optic guided missile. We feel there could be a high payoff there. You have to have something back in your rear area, but you don't need as much sophistication back there, so we are looking at the pedestal-mounted Stinger in the rear area to give some protection there.

Finally, you need a line-of-sight system up in the forward area that can catch the quick pop-up target and catch that fixed-wing as he comes in. What we are looking at is going out with an RFP to buy something off the shelf, it can be a missile, it can be a gun, or a hybrid, a combination of those systems. I believe we will probably get bids on all those and will have to sift them out to find out what the payoff will be.

Finally, none of this is any good unless you have a command and control system. In the past, we called that SHORAD C. However, it goes well beyond that, so we have changed the name to the Forward Area Air Defense Command, Control and Intelligence or FAAD C$^2$I. We feel without sensors, ground and air, we are not going to have the capability to pull all the systems together to do the job. That summarizes the approach we are taking today.

What is new? I think this is kind of important, because it all sounds new. The non-line-of-sight system we are going to shoot over the hill to try to get the hovering helicopter is new. The sensors or the FAAD C$^2$I are new. There is nothing new in the rest of those programs. They were somewhere in the Army program before.

*FORWARD AREA AIR DEFENSE*
*FY 87 BUDGET*

***RDTE: $269.5M***

O CONTINUE DEVELOPMENT FOR NLOS, FAAD C2I AND ANTI HELO TANK AMMO.

O COMPLETES LOS (FWD-HVY) ALTERNATIVE SYSTEMS EVALUATION, SELECT WINNER AND AWARD PRODUCTION CONTRACT.

O CONDUCT FOLLOW ON TESTING FOR PMS.

O COMPLETES RSS MISSILE DEVELOPMENT PROGRAM.

O START DEVELOPMENT FOR LOS (FWD-LIGHT) (PMS P3I).

***PROC: $90.8M***

O BUYS 22 PMS.

O PROCURES LONG LEAD ITEMS FOR LOS (FWD-HVY) PRODUCTION.

O BUY 74 ATAS FOR THE OH-58.

O BUY AN ADDITIONAL 180 STINGER RMP MISSILES.

Mr. DARDEN. What is the normal altitude for the hovering helicopter?

General WAGNER. He will probably be hovering at tree-top level. If he can get down in that clutter, he has a tremendous advantage. The Soviet helicopter today has some difficulty hovering at that level. However, with the new helicopters they are producing now, they should have no more difficulty hovering at tree-top level than we do. That is a lot of the problem, being able to pick him out of the clutter in the trees at long distances. That is the reason we are looking at something we can shoot vertically and take him out. We feel we will have a lot better success if we can do that.

The program we have developed, then, is the one you see on this chart. On the RDT&E side, it is $269.5 million this year. It is to continue development for a non-line-of-sight system. We already had dollars on what was the SHORAD C. That is shown here. We have dollars on the tank ammunition. We are going to continue development of that round because it could have a high payoff against the hovering helicopters. These dollars will be only for testing and evaluating the systems to give us the line-of-sight system or the direct replacement for Sergeant York.

It could be a missile system, a combination or a hybrid. We are giving them the chance to come in and tell us what is available in the marketplace, and then we are going to have to trade off the effectiveness of the system against its cost.

To try to give you an idea of what that would cost in procurement is very difficult because it can vary from a very cheap system to a very sophisticated one, which means it can go from $1 billion to many billions of dollars if you went from one end of the spectrum to the other. We have to look at that and see what the payoff is for the dollars. That is what that R&D is for, to evaluate it.

Next is the pedestal-mounted system. This is really putting a Stinger on, for example, on a HMMWV. It may or may not have a gun on it, too. We are going to go out in the marketplace, there are several people building those, and let them come in with an NDI approach. That was in our program before. We feel that if we can take the Stinger off of the man's shoulder and put it on a vehicle with better fire control, it is going to be a lot more effective. It will be more mobile on the battlefield, and we can reduce the number of men packing those around on their shoulders.

We are completing the Rosette Scan Seeker development of our Chaparral, and we are starting development for a line-of-sight system light.

Mr. DARDEN. Just a moment, General. We have got one question here.

Mr. BATTISTA. How much money is there for the architecture work related to the old SHORAD $C^2$ to interconnect the FLIR with the other short-range air defense weapon control systems?

General WAGNER. I can't give you specific dollars on that. The total amount in that for the FAAD $C^2$, and including the sensors and identification systems, is $122 million. There will be NDI sensors. We are not going to develop new ones. We are going to say: "What do you have available? You can come in and show us both air and ground versions."

Mr. BATTISTA. I thought the agreement you had with the committee on the Stinger RMP was a $40 million development program, to be followed by, you will come back and tell us how things worked out. There are 180 missiles in there for procurement.

General WAGNER. The RMP program is within the $40 million. We are completing that program. All of the missiles that are being produced will have the RMP capability, but the chip won't be cranked into production until about 1988. In other words, it will have the provision to put the reprogrammable module in the missile. The R&D will be completed on that within the $40 million.

Mr. BATTISTA. When will you be testing the RMP?

Mr. SCULLEY. That number, Mr. Battista, I think, was $47.5 million.

General WAGNER. It is coming in at that cost. RMP will be treated this year and next. In fact, the total R&D cost, I think, ends this year.

Any more questions on that? We know that cap, and it is coming in within that apparently without any problem.

Mr. **Battista**. That is with everything, engineering support services?

Mr. **Sculley**. Everything.

General **Wagner**. Next slide. What we are looking at for going over the hill is FOG-M. This particular system was developed at our Missile Command, and to tell you the truth, it was initially developed to kill tanks. It is a relatively simple system. You vertically launch it, it flies up, drops down to 100 meters in altitude and flies at 100 meters per second. It is flown by an individual, and is connected to a fiber optic cable. We can get ten kilometers range on that today. In fact, we have done that. We can probably get more than that, but that is about all we need for this capability now.

In the future we might also want to go out there for tanks. We know there is no problem going for tanks because we have hit tanks with them. As the FOG-M gets into the vicinity of the target, it locks on. Initially we are using a low light-level TV like we have used in the early work. Eventually we would want to go to an Image Infrared Seeker capability so we can get at night with it.

However, we have some time to do that. Until the enemy develops a full night capability, most of the air threat is going to be during the daytime. To see if this could possibly work, in November we flew a FOG-M missile at a helicopter on the ground to see if we could hit it with just a rotating rotor. It did destory it. Last month we flew a FOG-M and took on a UH-1 drone helicopter moving at 60 knots, 75 feet off the ground. The individual that fired it was a specialist fourth class who had been given 3 weeks' training and was able to guide it in until it could lock and kill the helicopter. It is a simple system to operate.

I don't want to fool you at all. This was not a tactical engagement because he knew where that helicopter was coming from, the general direction of it. But it was a test to see if it could be done. It wasn't one of those where he actually flew the FOG-M out and tried to find it, which you would have to do in combat. I have a short tape of this. I think it will show you what it did.

Dr. **Mansfield**. Could I ask a question while the tape is rewinding? When do you launch this? You certainly don't launch this to go and find helicopters.

General **Wagner**. You launch it when you get an indication from your FAAD $C^2I$ system. In other words, your command and control system will tell you that there are helicopters out there. Then you launch and go out and get them. $C^2I$ gives you the alerting and cueing on where targets are, you pick it up, and then you fly it in. FOG-M will also have its own passive sensor system. It will lock onto the target. You will see what FOG-M will do in this particular part of the video tape.

Dr. **Mansfield**. So in a real situation, you won't have much more or less information than this guy had on the day in question, right, there is a helicopter out there.

General **Wagner**. You would probably have about the same. I am saying he didn't have to search at all. You would probably go out, search and confirm the target location as you came in on a high altitude. We have done testing on tanks. We have never done it on helicopters. If you are going after the hovering helicopter, he is not going to be flying at that forward speed anyway.

(Film clip on.)

This is the vertical launch in slow motion. There the missile kicked off, and you can see the speed of it. It goes up, then it comes down and flies at about 100 meters.

He sees the helicopter in the distance. You will see the missile lock on in 1 minute. He is just tracking it himself now. He has gotten off the target a little bit. Now you saw it lock on. You are actually looking through the front end of the missile as it comes in on the target.

As I have said, that was really a proof of principle. FOG-M is not something that we would go out and produce tomorrow, but we feel that we could produce it very quickly with a minimum amount of research and development.

Mr. BATTISTA. General, why wouldn't you produce it tomorrow? Because you have got a set of drawings—in fact, that airframe was put together in the kitchen of one of your people down there. Why don't you just take the prints, go to industry and say compete it and build it?

General WAGNER. That is what we are going to do. Before we field it, you have to build a light and heavy launcher, logistics support and so forth. I think we can do it faster than most people would tell you we could, but that is essentially what we want to do. Give industry the plans, and let them compete to build it.

Dr. MANSFIELD. While you are putting logistics into the launch, no one is going to mess around with the airframe? What Mr. Battista is worried about is, yes, you need logistics, yes, you need the launcher, why do you need to——

Mr. BATTISTA. In other words, don't make it better, it works fine.

General WAGNER. It is our plan not to make it better initially. We are taking that approach in buying communications gear today off the shelf, and we think we can do it in something like this. You have to improve the Seeker to give it the low light capability. You could have the daytime FOG-M capability very quickly. We think that we could probably field a day only FOG-M and have it in numbers in the field by probably 1989, which is pretty fast. We go out on a contract this year for prototypes to be used in operational testing. Then we get into production and should be able to get it out. That is with daylight capability.

That is basically, sir, what is going on in the air defense arena. It appears complicated, but I think it is the right way to go. What we have done is pull all these systems together into one coherent program, which we didn't have before, and that is how we are trying to sell it. That is how it has been accepted by the Secretary of Defense.

Mr. DARDEN. How much money do you have for the FOG this year in the budget?

General WAGNER. I have got that here, sir. The FOG-M is $88.3 million. That is R&D this year. Actually, if you look in air defense, you would find $83.3. But we were bringing this program along very slowly as an antitank system, and there is $5 million in that line. We have added the two together, so the total amount is $88.3 million.

Mr. **Darden**. What do you think about the use of the Hellfire missile on the back, as an antitank?

General **Wagner**. Personally, sir, if I believed that I needed a greater capability than what I have fielded very quickly, I would put it on the back of a vehicle and field it. It has some disadvantages because you have to have a man on the ground to designate for it or a man airborne to designate for it, but I know it has a tremendous capability, it has a long range. We have tested it, incidentally, in a SKUNK works project out at the Ninth Division. So if we were in a situation where we felt we couldn't cope with the enemy or were having problems in the development of a follow-on TOW, for example, I would personally field it as an interim system.

Mr. **Darden**. The reason I mention that and others is most of my contemporaries, a good many, were actually involved in combat, of course, were in the Vietnam war, and every time we have any type of discussions about weapon systems, they get back to the point of saying "We have been in combat, we want something simple, we want something reliable," and they—again, this shows you the orientation of I guess my contemporaries, but it is not toward anything exotic, it is toward something reliable, something simple and something totally dependable. That is why I wanted to bring that up.

Also, I like your concept very much of the Stinger. I think it is something that works, it is something you can go ahead with in a certain short period of time and have available, can you not?

General **Wagner**. Yes, sir. That concept—you may or may not know—was also developed as a SKUNK works project for the 9th Division in their ADEA program. We are taking that one off the shelf and are going to go out with an RFP. Luckily, we are going to compete it. There are several available for competition.

Mr. **Dickinson**. Several what available?

General **Wagner**. Several versions of a Stinger, mounted on the rear of a HMMWV so we can have better control of it and you can get rid of a lot of these people you have carrying Stingers around in the open on their back.

Mr. **Dickinson**. Tell us about the development of the Stinger. What are we building into it it doesn't have now? You say there are several versions you are looking at?

General **Wagner**. On the Stinger, sir, the only thing going into it it doesn't have now, is a reprogrammable microprocessor so we can use it against various flare threats, et cetera. That is a program we had $47 million plus to complete. We are on target on cost for that. The ones we will be producing starting this year will have the position to put in the chip, they will not have the chip yet. That will go in in about two years. All of them will eventually have that.

Mr. **Dickinson**. Will there be a difference in the Stinger itself, the missile they put on helicopters for air-to-air——

General **Wagner**. Exactly the same. They are all interchangeable.

Mr. **Dickinson**. The same missile?

General **Wagner**. Yes, sir.

Mr. **Dickinson**. And the vehicle that carries it?

General **Wagner**. Yes. In fact, we demanded that. They didn't do anything to change it, so we could use it whichever way we want.

Mr. Dickinson. How easy is it decoyed with a flare or whatever?

General Wagner. I can't cover all of the details of that in here, but it can be decoyed with flares today. That is the reason we are changing it.

Mr. Dickinson. It will, in effect, have a memory?

General Wagner. What it does, it knows what is the flare and what is not the flare and goes through and hits the target.

Mr. Dickinson. You are coming along pretty well with that?

General Wagner. Yes, sir.

Mr. Sculley. It gives the future system the flexibility to handle an increased threat.

Mr. Dickinson. How are we coming with the HMMWV? Do you have any problems there?

General Wagner. Sir—as you know, it is in production. The principal problems we have had are with the heavier version of it. The lightweight version, the common utility one, is doing well. We had the problem on the brake pedal that broke. It was a vendor that wasn't welding them properly, and they broke. Those are all being replaced at the contractor's expense. Everything we have had has been fixed at the contractor's expense. We had some bearing problems, those have been fixed.

The principal problem we are still having on the heavy one is with the rear differential. If they can't fix that, we are not going to buy the heavy version. It should be something you could fix, but we have some problems in testing it.

Mr. Dickinson. Who is making that now? It has been handed off a couple times.

Mr. Sculley. A.M. General was the winning contractor, and they subsequently were purchased by LTV.

Mr. Dickinson. LTV has it now?

Mr. Sculley. Yes, sir.

Mr. Dickinson. I couldn't remember.

Is cost containment adequate there? Do they have a substantial cost growth, or are they meeting the target?

Mr. Sculley. It is within the target. We are in a fixed price environment, sir.

Mr. Dickinson. Thank you. That is all I have right now. Wait a minute, just one exception.

In the opening statement, and also when I talked to General Wickham and others, there is evidence of very strong interest in air-to-air capability for most anything flying it puts in the air. Is there any reason the Stinger won't go on—how much does the Stinger weigh?

General Wagner. Twenty-nine or 30—about 30 pounds.

Mr. Dickinson. A man carries it. So there is no problem putting it on a LOH or any rotor wing going, is there?

General Wagner. No, sir. In fact, in procurement, we are buying 74 sets of launcher pads for the OH-58's. We are still qualifying it on some of the other aircraft. We already are working on it, as you know, on the Black Hawk, and will be qualifying it on our other aircraft.

Mr. Dickinson. Will you also put it on the Black Hawk?

General Wagner. We are qualifying it on the Black Hawk.

Mr. Dickinson. You have it both on there?

General **Wagner**. That is the only weapon the Black Hawk would have right now, sir. We could also put a Hellfire on it, we qualified that.

Mr. **Dickinson**. That is what I meant. It is capable of——

General **Wagner**. Yes, sir. It doesn't have the sophisticated fire control for the Hellfire, but it could launch it and it could be designated from another designator.

Mr. **Dickinson**. I was just, Monday of this week, last week—I don't know, I will be glad when the week is over—I went up to Connecticut to this plant, and they showed me what they were doing so far with the new LHX, which is very impressive. Are you satisfied with our progress on the LHX?

General **Wagner**. Yes, sir. In fact, that is the next program I was going to discuss. That is a good question, though, sir. We will go ahead on that now if you have questions.

Mr. **Dickinson**. I will withdraw the question then. I am sorry. I have been in and out, but I have more people in town than I know how to meet with right now. I am sorry that I missed part of your presentation, but we will catch up with you.

Mr. **Darden**. I believe Mr. Battista had one question before we went on to LHX.

Mr. **Battista**. I had two, one generated by Mr. Dickinson.

If you are going to have this in 1989, this would be a beautiful weapon to launch from the helicopter as well. You are limited by the fire control system only, and there is no reason you can't spool out 10 clicks of fiber wire against another helicopter. That is even——

Mr. **Dickinson**. Are you talking total now?

Mr. **Battista**. Fiber optic guided missile. They had a film before you came in shooting down a helicopter flying at 60 knots.

The second question triggered a point in my mind. We visited the Porsche plant, got a presentation on the Weasel, 48 miles an hour, 2.75 tons, could actually carry 11 men with a plug in it behind the metal seams there. About 300,000 to 400,000 a copy estimated price. Just a beautiful weapon for a FOG-M or a Stinger or a TOW, or whatever, not as a replacement for the Bradley, as an augmentation for the Bradley for the light divisions.

Have you looked at the Weasel?

General **Wagner**. The Weasel was one of those items they also looked at in the 9th Division. The principal thing that drove us away from it at that time was the cost of it for the protection level. It is very small and has only small arms protection. It is a good vehicle. I looked into this about a year ago, but I haven't looked into it since then, after the 9th decided they weren't going to go for it. It wasn't being bought in the German Army either.

Mr. **Battista**. They have a production decision next year.

General **Wagner**. We wouldn't want to buy it for ourselves only. But it is a good vehicle. In fact, there are a number of those if you want to go offshore.

Mr. **Dickinson**. There are five or seven modes of the Weasel. Do people carry two-man crews, carry——

General **Wagner**. It is a good vehicle. The 9th was high on it.

Mr. **Dickinson**. If you can get four of those comprised of one Bradley and mix them up, it has got a fairly quiet engine, a dependable engine, I believe, which is pretty good. You know, I can envision a battlefield with a bunch of those things on there. They would be tough. They would be tough, along with whatever else you had.

Mr. **Battista**. The main question I had I didn't get to, we understand on something, a test set, that the Army and Navy have a requirement for—right now the designation area, it is the APM 424. The Army expressed a rather high requirement for it, and we have been in production on this thing. My understanding is you had to go through the Air Force contracting office, and you are getting left high and dry in terms of meeting your requirement and the Army's requirement because somebody in the Air Force has decided that this thing has to be recompeted for some reason unknown to anybody, and, you know, we go back over history and according to the data I have, this test set reduced the time for testing the IFF system from 40 minutes to less than a minute.

Under the current budget restraints, when we might be running the risk of losing people, it would be hard for me to understand why we can't get on with a system you have asked for, you have expressed a requirement for, it seems to me bogged down in the bureaucratic mess. Do you know anything about it?

Dr. **Sculley**. I am not aware of that particular situation, but I can surely find out and get back to you in a matter of a day.

General **Wagner**. I am not either.

Dr. **Sculley**. I will send you the answer.

Mr. **Battista**. They actually sent the money, and they haven't done anything with it as far as I know, so you are even losing interest.

General **Wagner**. I get about 100 notes a day on problems, but I don't have that one. I will find out what the story is. Any other questions on that?

[The following information was received for the record:]

The AN/APM 424 is a handheld transponder test set. It provides a rapid, before take-off comprehensive and reliable check of all transponder modes including identification friend or foe. This is a Tri-Service program administered by the Air Force. The Army is attempting to purchase 150 this year. The last procurement was in Fiscal Year 1984. The Army did not participate in that procurement. The Fiscal Year 1986 program is competitive with expected award date of November 1986.

Mr. **Darden**. Just one question. On this diagram here, what is this high platform, at the very top?

General **Wagner**. That would be the airborne sensor. That may be on a RPV, it may be on a helicopter standing back farther to the rear. We are going to look at what is available off the shelf to be the airborne sensor for your command and control systems—the intelligence part of it. That decision has to be made on what they come in with off the shelf because we are not going to go out and develop a new sensor.

Mr. **Darden**. We are not going to go with that 13 RVP, are we?

General **Wagner**. No, sir.

Mr. **Darden**. Go ahead with the LHX.

**LHX ➧ WHY LHX?**

**Existing Light Fleet Major Deficiencies**

ARMY
AVIATION
MISSION
AREA
ANALYSIS
(AAMAA)

- Fleet Age/Obsolesence
- Economic and Logistic Supportability
- Battlefield Survivability
- Operate in High/Hot Environment with Mission Payload
- Adverse Weather and Night Capability
- Standoff Range, Multi-Target Engagement Capability
- Strategic Deployment Capability
- Air-To-Air Self Defense Capability

*DEMAND LHX*

General WAGNER. What I want to look at now and just discuss a few points on is the LHX. As you know, we've got about 7,000 OH-58's, OH-6's, and AH-1's that eventually need to be replaced as we approach the year 2000. As we looked at some of the technology highlighted for you earlier, such as fly-by-light and the capability of using completely composite aircraft, it seemed to make a lot of sense that if we were going to buy a helicopter in the future, we should look and see if we could make use of that technology.

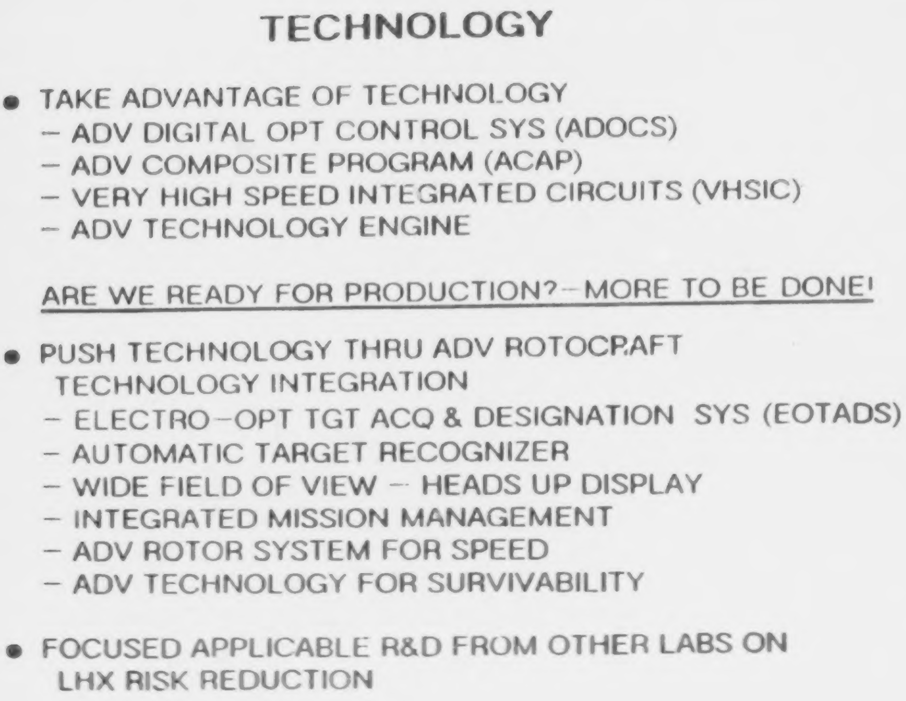
Also, if possible, we would like to get rid of the second pilot. We are not absolutely certain we can do that yet, but our goal is to go to a single pilot aircraft. If you are going to do that, you have to use technology in the electrical optical arena, and things of that sort. What we have done on the LHX, instead of moving full bore into a program is to do the front-end work. We said we have got to do the front-end work first in the technology base before we make a decision to go ahead. If we can do all that, we feel we can get an aircraft with these capabilities. But we want to make sure we do our front-end work right.

## SHOULD WE INVEST IN NEW HELICOPTER TECHNOLOGY?

- IMPROVEMENTS BEYOND AH64/UH60/AHIP
  - COMPOSITES VS METAL & RIVETS
  - FIBER OPTICS VS BELL CRANKS, CABLES, MECHANICAL LINKAGE
  - SIGNATURE REDUCTION (−DB) AND IR, ACOUSTIC SUPPRESSION
  - OPERATION AND SUPPORT REDUCTION
  - FIRE CONTROL SYSTEM – INTEGRATED AUTOMATION VS MANUAL
  - EXPANDED FLIGHT ENVELOPE – AGILITY & MANEUVERABILITY
  - BALLISTIC TOLERANT COMPONENTS
  - ON BOARD DIAGNOSTICS

Next chart. We said this is what we see is in technology today that might have a high payoff on an aircraft of the future. We have already talked about the composites, the fiber optic linkage and so forth. We want to get the operations and support costs down, because if there is a single thing that costs us money, it is the training of mechanics and so forth, so we want to put in self-contained diagnostics and build it out of items that don't require a lot of repair parts.

We need automation in the fire control if we are going to go with a single pilot. That is a tough one, and we have to make sure we are on track there. We want to give it growth potential, and that is the reason we are putting enough power in it so in the future, after we start producing them, we don't have an under-powered bird.



## TECHNOLOGY

- TAKE ADVANTAGE OF TECHNOLOGY
  - ADV DIGITAL OPT CONTROL SYS (ADOCS)
  - ADV COMPOSITE PROGRAM (ACAP)
  - VERY HIGH SPEED INTEGRATED CIRCUITS (VHSIC)
  - ADV TECHNOLOGY ENGINE

ARE WE READY FOR PRODUCTION?—MORE TO BE DONE!

- PUSH TECHNOLOGY THRU ADV ROTOCRAFT TECHNOLOGY INTEGRATION
  - ELECTRO—OPT TGT ACQ & DESIGNATION SYS (EOTADS)
  - AUTOMATIC TARGET RECOGNIZER
  - WIDE FIELD OF VIEW — HEADS UP DISPLAY
  - INTEGRATED MISSION MANAGEMENT
  - ADV ROTOR SYSTEM FOR SPEED
  - ADV TECHNOLOGY FOR SURVIVABILITY
- FOCUSED APPLICABLE R&D FROM OTHER LABS ON LHX RISK REDUCTION

Next chart. So what we did in our technology base for example in advanced digital optical control systems, was to develop the essential technology we needed for the LHX. In our composite program, we directed it at the LHX—in our VHSIC program, we have undertaken as one of our major programs in the Army the integration of VHSIC (very high speed intergated circuits) into the program for LHX. With the advanced technology engine, we are on contract in a competitive atmosphere right now. Those have all paid off from the technology base.

### ARTI

If you look at everything we have done in the technology base, there are about 14 other programs going on just to support LHX. Directly related to the LHX is something we called the advanced rotorcraft technology integration program, or ARTI, and that is the program you see in this year's budget we want to complete. It is looking at the electrical—optical acquisition capability, and automatic target recognizer. We need to breadboard this because if we can't do that properly we will have problems. We are doing work on a heads-up display, a helmet display that will help us in this particular aircraft. There is also wind tunnel testing.

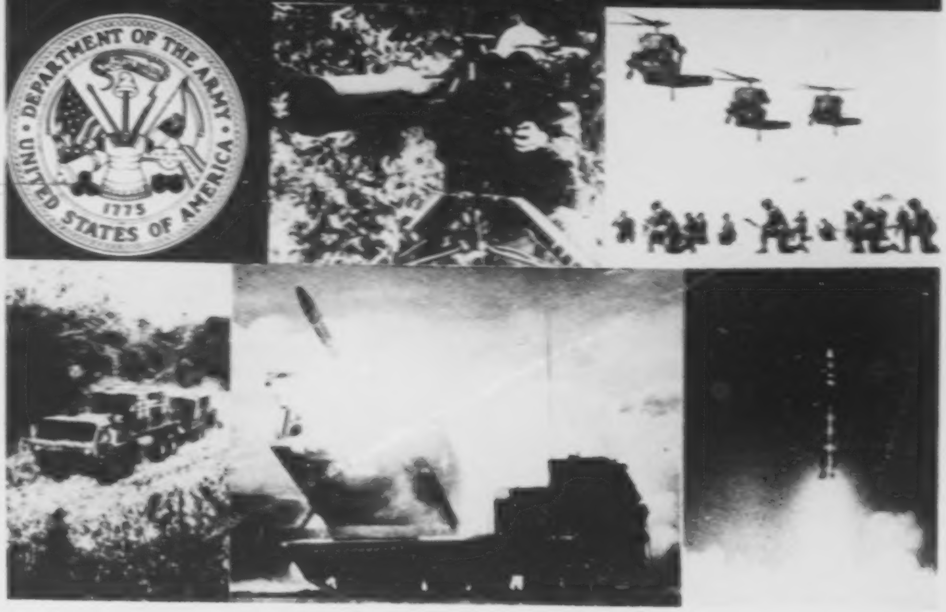
Mr. DARDEN. Excuse me. We are in a situation right now where we have got about 10 minutes left on a vote, then we have a meeting scheduled with some of our counterparts from Italy who are here at 4 o'clock. This Mr. Dickinson and I regard as a critical program. We would like to go into some depth with you. So if it is acceptable to everyone, we could resume tomorrow at 2 o'clock. Is that agreeable with you?

General WAGNER. Yes.

[Joint statements of Jay R. Sculley and Lt. Gen. Louis C. Wagner, Jr., follow:]

# EQUIPPING THE UNITED STATES ARMY

Statement to the Congress on the
FY 87 Army RDTE and
Procurement Appropriation



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## THE ARMY'S FIRST PRIORITY

# THE SOLDIER

DEPARTMENT OF DEFENSE

**DEPARTMENT OF THE ARMY**
WASHINGTON, D.C. 20310

February 18, 1986

Members of Congress:

The Army's pursuit of modernization and a balanced material acquisition program is underway to meet the goal of equipping our Army to respond to a constantly changing worldwide threat. Force modernization, in reality barely begun, is essential in an Army that has little choice but to capitalize on advanced technology. If today's research and development is to bear fruit in the future, the effort must focus on achieving key operational capabilities in less time with fewer false starts. The Army's primary focus is on five Key Operational Capabilities: Command, Control and Communications (C-Cubed); Reconnaissance, Surveillance, and Target Acquisition; Battlefield Sustainment; Battlefield Lethality and Soldier Performance Enhancement. We will continue stressing the procurement of off-the-shelf "non-developmental" systems to insure a reduction in equipment fielding times and savings in development costs.

The following introduction provides a brief overview of the research, development and acquisition objectives and ongoing efforts to meet these objectives. The weapons systems and other equipment are categorized by specific Army mission areas and are designed to show the current strengths and weaknesses in these mission areas. Our hope is that the enclosed discussions will make the Army's request for each system meaningful by describing its intended use on today's, as well as tomorrow's, potential battlefield.

In addition to this statement, we are also making available to you the "1986 Army Weapons Systems" handbook, a consolidated reference for a number of our weapons systems.

It is an honor to represent the Army in working with this session of the 99th Congress.

Louis C. Wagner
LOUIS C. WAGNER, JR.
Lieutenant General, GS
Deputy Chief of Staff for
Research, Development and
Acquisition

J R Sculley
J. R. SCULLEY
Assistant Secretary of the Army
(Research, Development and Acquisition)

## Dr. Jay Raymond Sculley

**Assistant Secretary of the Army**
**(for Research, Development, and Acquisition)**

Dr. Jay R. Sculley, the Assistant Secretary of the Army for Research, Development and Acquisition, took office on October 13, 1981.

As Assistant Secretary of the Army for Research, Development and Acquisition, Dr. Sculley is the Scientific Advisor to the Secretary of the Army and is responsible for Army wide policy development and oversight of research, development, test and evaluation programs and of materiel acquisition management, policies and procedures. He is also responsible for implementation of worldwide security assistance policies and international programs.

Dr. Sculley is a graduate of Virginia Military Institute where he received a Bachelor of Science degree in Civil Engineering in 1962. Following graduation from VMI, he served as an officer in the U.S. Air Force and later was a designengineer with the Dupont Company before earning his MSE and Ph.D. at the Johns Hopkins University.

In 1970, Dr. Sculley joined the VMI faculty and served four years as an assistant professor of civil engineering before electing in 1974 to leave teaching and enter industry. He was General Management of Corrugated Services, Inc., a Texas paper recycling company, for one year before returning to VMI in 1975. During his faculty years at VMI, he was actively involved in engineering research through the VMI Research Laboratories, Inc. He is the author of numerous papers and has been elected to Who's Who in Engineering. At the time of his appointment by President Reagan, he was Professor and Head of Civil Engineering, VMI's largest academic department.

Since assuming his present position, Dr. Sculley has been instrumental in improving the management and cost discipline of major hardware acquisition programs. He directed the integration of technology base efforts throughout the Army and expanded the program for centers of excellence at American universities for Army sponsored research. He has also initiated programs to upgrade the training, development and utilization of people throughout the research, development and acquisition field.

Dr. Sculley is married to the former Peggy Lee Winkel of Baltimore. They have one daughter, Rebecca Lee.

## Lieutenant General Louis C. Wagner, Jr.,

**USA Deputy Chief of Staff**
**for Research, Development, and Acquisition**
**Department of the Army**

Lieutenant General Louis C. Wagner, Jr., born on 24 January 1932 in Jackson, Missouri, was graduated from the U.S. Military Academy in June 1954 and began his military career as a Second Lieutenant, Armor. General Wagner's early assignments included command positions with the 11th Airborne Division in the U.S. and Germany followed by an assignment to the 6th Armored Calvary. General Wagner also served two tours in Vietnam as an advisor for infantry and armor units, attended graduate school at the University of Illinois, and instructed at West Point for three years.

Key assignments in General Wagner's military career include command of a light airborne armored battalion at Fort Riley and Fort Bragg, command of the 1st Brigade, 3rd Armored Division, Germany and Commander of the U.S. Army Armor Center and Fort Knox. He was also assigned to the Office of the Chief of Staff, U.S. Army. Additional DA staff positions included Deputy Director, Materiel Plans and Programs and Director of Combat Support Systems, Office of the Deputy Chief of Staff for Research, Development and Acquisition. Prior to his current assignment he served as Assistant Deputy Chief of Staff for Operations and Plans for Force Development.

General Wagner's military education includes attendance at the Armor Basic and Advanced Courses, Ranger and Airborne Schools, U.S. Army Command and General Staff College and the Naval War College.

His military awards include the Distinguished Service Cross, Distinguished Service Medal, Silver Star, two awards of the Legion of Merit, Bronze Star Medal, Meritorious Service Medal, two awards of the Air Medal, three awards of the Army Commendation Medal, Purple Heart, Combat Infantryman Badge, Senior Parachutists Badge, Ranger Tab, and various foreign decorations.

General and Mrs. Wagner, the former Mary Judith Gifford of Webster Groves, Missouri, have three children: Susan, Stephen and Amy.

General Wagner assumed his duties as Deputy Chief of Staff for Research, Development and Acquisition on 1 August 1984 following his promotion to Lieutenant General.

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of qualitative superiority That program has gone well We have developed modern systems and are now acquiring them and modernizing our force

As we proceeded with our modernization program, the Soviets moved much more aggressively than any of our estimates predicted They increased their numerical advantage more than expected and, more alarmingly, have reduced, and in some cases reversed, the qualitative advantage we held In Europe this means that Soviet and Warsaw Pact forces have fielded a modern motorized and armored force, a dense multi-system air defense, modern attack aircraft and helicopters, and a growing conventional tactical missile threat By many of the measures which we have used to compare our forces, we have indeed lost ground Consequently, the uncertainties for the Soviets in conducting a conventional campaign in Europe have been reduced and so has the deterrent posture of the US and NATO forces

At the same time the military situation in the Third World has worsened Soviet military power and influence have been increasingly projected there In Southeast Asia, in particular, Soviet military equipment has been used to establish large and modern mechanized and armored forces Developments in Africa and Latin America also confront us with a militarized Third World which is unstable

Where have these developments placed us? While we have been modernizing, the Soviets have been increasing their numerical advantage and eliminating the qualitative gap However, as these developments emerged, our military planners recognized the need to meet them, first, by developing doctrine for the employment of our new weapons and, second, by devising new organizations for our combat forces to meet our increasing worldwide commitments

In 1972, the Army's primary mobility and firepower weapons systems were rapidly approaching obsolescence A clear and immediate requirement to modernize these systems was evident The Army leadership established a program to focus technology and development efforts on systems identified as being most crucial to execution of the Service's combat mission

Five major development efforts emerged, termed the "Big Five" These systems, which will provide the mobility and firepower necessary to support the Army until the year 2000, are now being produced and fielded They are the M1 Abrams main battle tank, M2 and M3 Bradley fighting vehicles, AH-64 Apache attack helicopter, UH-60 Black Hawk helicopter and the Patriot surface-to-air missile system

The success of the Big Five programs was attributed to the focus established by the Army leadership, the Congress and defense contractors Today, the requirement to distribute scarce resources to achieve maximum capability is more challenging than ever before In 1972, our doctrine was oriented toward heavy forces, today we must have the capability to realistically engage threats across the full spectrum of warfare, from terrorism to the nuclear battlefield The rapid advancement of technology, coupled with its broad application to weapons systems, makes it imperative to define requirements, develop systems and field hardware in the shortest time possible

Recently, the Army Staff concluded a short, intense study to identify follow-on initiatives to the Big Five From that study, a concept has been established to guide development and fielding of weapons between now and the year 2000

The concept centers on "key operational capabilities," or those warfighting capabilities the Army must have to fight and win on any battlefield The key operational capabilities provide a means of identifying the necessary systems, programs and technologies to ensure that priority Army research, development and acquisition efforts are supported in the annual program, planning, budgeting and execution cycles. The key operational capabilities are identified as: reconnaissance, surveillance and target acquisition (RSTA), command, control and communications (C3), battlefield lethality, battlefield sustainment and soldier and unit performance enhancement. Other capabilities such as strategic and intratheater lift were recognized as being critical, but are less affected by Army research, development and acquisition activities.

The concept of key operational capabilities capitalizes on those technologies where the United States has an advantage, for example, microchip technology and biotechnology. This competitive edge provides the potential to achieve a significant improvement in war fighting capabilities, which will offset quantitative deficiencies.

The potential for improvement extends across the entire spectrum of fighting capabilities, including the areas of battlefield synchronization and deep-attack capability. Such an improvement will not only change the nature of land warfare but will also shape it in U.S. terms as opposed to those dictated by a potential enemy.

AirLand Battle is a major advance in doctrine. It addresses the battle activity in the rear, close in, and deep areas as concurrent, synchronized operations. This doctrinal development is particularly bold in its concept for deep attack, that is, projecting combat power deep to attack the second and third echelons of the enemy force. This aspect of AirLand Battle is generally described as producing delay and disruption of these echelons, but by doing this, it does much more. Deep attack in AirLand Battle places the whole concept of Soviet campaign operations at risk. Thus, as we implement this doctrine, we will greatly increase the margin of uncertainty for the Soviets regarding the outcome of any conventional campaign and, therefore, restore the deterrent posture of our conventional forces.

It is important to note that this is a joint doctrine which provides the framework within which the Army and Air Force coordinate plans for R&D programs and for operations.

AirLand Battle is already being implemented with the forces and equipment now in the field. However, the full development of the power of this concept depends on the exploitation of emerging technologies in sensors to see deep, in smart munitions to strike deep, and in data processing and telecommunications to rapidly manage these resources. Our scientific and technology base in the US uniquely positions us to do this and, thus, to establish a major advantage over our adversaries in employing weapons on a modern battlefield.

Since the full capability of AirLand Battle doctrine will be underwritten by science and technology, it is particularly important that we sustain an aggressive R&D program to support it. To do less would be to ignore a major advantage we have in applying science and technology to leverage our combat power. To do less would also risk assuring the success of the Soviet strategy to develop superiority by fielding larger forces and matching or exceeding our weapons in quality.

Our plans for improving the capability of our light forces also require an aggressive applied technology program. The reorganization of these forces under the Army of Excellence program will provide for greatly increased deployability. These forces, however, need greater firepower to meet modern mechanized and armored threats.

A major task of the Army is to achieve synchronization of the AirLand Battle. It is expected that the potential enemy will outnumber us in weapons and in manpower. Our advantage must be gained by bringing to fruition the nation's capability in high technology, so that we may field the systems necessary to control the battlefield and offset enemy numerical superiority.

Another major task is to field a deep-attack capability for heavy and light forces. We must be able to detect, identify and attack enemy follow-on forces, command and control centers, and logistics operations. With their disruption, we can be successful; without it, we cannot.

One must never forget that the most crucial battle will be fought at the forward line of troops where the infantry and armor soldiers, with the support of all other arms, ultimately win or lose the battle. Hence, we continue to place geat emphasis on the weapon systems that are key to this battle.

The Army must, of course, continue to define and refine joint service operational capabilities. We fight as a team with the Air Force, Navy and Marine Corps and must coordinate our RDA programs with theirs.

The key operational capabilities provide the basis for the development of systems and programs to be emphasized in the 15-year period ahead. Specifically, each system in development must clearly demonstrate that its presence will significantly enhance the warfighting capabilities of the Army and that it will go into production before the year 2000.

The soldier is the ultimate recipient of all of our research, development and acquisition efforts. Today's soldiers are exceptional. They are well qualified, physically and mentally toughened by their training and led by competent and caring leaders at all levels.

Proper soldier-machine interface is receiving increased emphasis in the design of all our equipment. We continually encourage weapons makers and Army program managers to pay more attention to soldier-machine interface problems as they lay out a new system in the concept formulation stage. The soldier must be "in the loop." We ensure that proper attention is paid to the manpower function and requirement in relation to the hardware to make the system far more effective in battle.

The capabilities of our soldiers will be a determining factor in system design. With fierce competition for top-quality recruits facing the Army in the future, both qualitative and quantitative personnel demands will become critical. Weapons and equipment must be designed to fit the soldier and his fighting environment. Program managers and laboratory directors are insuring that the man-machine interface effort makes the machine fit the soldier. Proper equipment design can reduce the soldier's work load in the high stress combat environment.

Emphasis on soldier performance enhancements is producing increasingly improved support items for the individual soldier. New clothing and equipment technologies mean increased survivability for the smaller and more lethal force of the future. These include research in chemical fibers and fabrics to optimize flame resistance and relief of heat stress; evaluation of new experimental fabrics for ballistic protection; development of improved chemical protective clothing and equipment systems; improved desert camouflage and infrared signature suppression and lightweight cold weather protection. Microclimatic conditioning units for vehicle crews will be fielded in the M1A1 Abrams tanks.

The M1 tank is being brought to a new level of capability with the fielding of the new M1A1 model and plans for a future package of improvements for that superb tank. The M1A1 improvement program is aimed at both improved effectiveness and operational and sustainment (O&S) cost savings. The effectiveness improvements are:

- An independent thermal-imaging night viewer for the tank commander.
- Improved commander's weapon station.
- Improved range finder.
- Better survivability.
- Driver's thermal viewer.
- A battlefield management system.

The research, development, test and evaluation (RDT&E) began in fiscal year 1985, and introduction to tank production is scheduled for August 1988 or sooner, if possible.

Thinking beyond the M1-series tanks and M2-M3 fighting vehicles, we are developing a concept for a family of future armored combat vehicles. Scheduled for a late 1980s research and development start, this program will give the Army significant improvement in force effectiveness by exploiting high-technology improvements. The combat vehicle family will support our needs well beyond the year 2000.

Another example of the emphasis on increased lethality is in the munitions area. Technology is dramatically altering the approach to fire support. Massed fires are becoming precision fires. Advanced munitions will be directed at targets rather than at points in space. Their lethality will result from having a self-contained capability to select targets and home in on them.

These "smart" munitions represent the most significant change in conventional indirect-fire support in the Army's history. Microelectronic technology makes it possible to build into missiles and projectiles the ability to detect targets with a variety of advanced sensors. This technology will significantly reduce logistics and manpower requirements while increasing lethality.

The Army's current force structure initiatives reflect changing strategic concerns. As the focus shifted from Vietnam to the potential armored and mechanized battlefields of NATO Europe, force structure became heavier to counter the Soviet threat. Therefore, we applied technologies to support a heavy mechanized force; but in light of the current need for rapid deployment, we are seeking ways to reduce the average weight and size of equipment. Exciting advances in this process have produced a new nonmetallic composite armor, which has been tested on the M2 and M3 Bradley fighting vehicles. This plastic armor, reinforced with E-glass and S-2 fibers, has been demonstrated on a Bradley turret, with a weight savings of 15 to 20 percent. An unanticipated finding is that the glass laminate is a better damper of sound and vibration from the main gun than aluminum.

Trends in the force at large also reflect down-sizing. For example, the advanced field artillery tactical data system (AFATDS) now in development will be considerably better and smaller than its predecessor "Tacfire". In addition, the logistics community will replace large computers with smaller and easily portable models.

The Army is emphasizing improvement in ammunition logistics. The new initiatives include improved plastic packaging for current and future ammunition that will be lighter, less bulky, easier to handle, cheaper and will be easier to decontaminate, by possessing better nuclear, biological and chemical protection characteristics. A technology base program has been established for improvement of ammunition packaging and handling.

The demand for logistical support can be reduced by implementing the down-sizing and weight reduction initiatives in our "Army of Excellence" force structure goals. One of the driving factors in down-sizing the force is to make it more supportable and deployable; however, the anticipation of greatly accelerated consumption rates of supplies and attrition of equipment have made the challenge of improving our support capability even tougher.

The Army has recently established a number of "battlefield sustainment objectives." They reflect the complex nature of sustainment issues, but are ultimately concerned with reducing the demand for logistical support. The objectives are:

- Balance prepositioned war reserve stocks against requirements
- Significantly reduce maintenance requirements.
- Eliminate unneeded weight and bulk.
- Reduce the money and manpower demands of the logistics system.
- Field survivable logistics support systems
- Create a capability to manage mass casualties
- Protect industrial base resources

Industrial base preparedness is a matter of great concern. Wartime sustainability requires funding support for the necessary mobilization manufacturing capacity in U.S. industry. The objective of this program is to satisfy materiel demands at a prescribed level within one year of the decision to expand production. These plans involve billions of dollars and have not been well supported in the past. We must focus on this in the future, within the constraints of a limited budget.

We must maintain a limited number of government-owned manufacturing facilities which are either government or contractor operated. These plants manufacture major items, large caliber munitions and special propellants that. Funding to support a "surge" production capability for selected, highly critical items is essential.

The Army is not standing still. Force modernization is real and must be completed. While we are working at improving our force through acquisition of new systems we must diligently conduct research and development for the future or we will place ourselves in the dilemma that faced us following the Vietnam conflict. To control this monumental task requires that we all work together to provide our most important asset—the soldier—the equipment needed to perform in a most effective manner. The RDA community is totally dedicated to that effort.

## TECHNOLOGY BASE

Unrelenting quantitative and qualitative advances by our potential adversaries underscore the necessity for realistic, comprehensive, and innovative long range RDA planning for our Army of Excellence. Technology and telesis (progress that is intelligently planned and directed) are more important now than ever. During the past year, we have continued to improve our long range RDA plan, which is the starting point for our budget and 5-year plan preparation, and the roadmap for our technology base investment strategy. Our plan is built upon realistic threat forecasts, AirLand Battle Doctrine, frank assessment of our deficiencies as identified by the Battlefield Development Plan and Mission Area Analysis process and solid technology forecasting. The resultant technology base investment strategy matures technologies needed by future systems, exploits our current technological advantages, accelerates high leverage technologies and nurtures emerging technologies. Our hierarchy of RDA plans is extensive, comprehensive, consistent, and ranges from the HQ DA Long Range RDA Plan to the Mission Area Materiel Plans of our major development commands to the science and technology plans of our laboratories.

This year's FY88-2002 long range RDA plan supports achievement of five Key Operational Capabilities which are prerequisites to victory on the future battlefield. Capitalizing on those high leverage and emerging technologies for which we have an advantage, the concept of the Key Operational Capabilities permits us to realize the full potential of our nations technology capability.

The technology base is maturing technologies in time for future systems development and product improvements of current systems to eliminate deficiencies and seize opportunities. One example is the Light Helicopter Family (LHX) program. Army laboratories working with the other Services, NASA and industry are maturing the technologies required for LHX. A FY88 full scale development start for LHX would not be possible without these efforts. Examples include advanced composite airframe structures, very high speed integrated circuit technology insertion, crew workload AirLand and man-machine interface simulation, advanced digital-optical flight control system, sensor fusion, automatic target recognition, survivability demonstrations, and expert systems for diagnostics. This technology is important to several other future systems such as the Armored Family of Vehicles currently in concept formulation. The LHX will be the first rotorcraft designed from the outset with the aid of extensive engineering simulation, mission simulation and wind tunnel testing.

The Army technology base continues to integrate, focus and apply high leverage technologies for each of the Key Operational Capabilities.

- Reconnaissance, Surveillance and Target Acquisition (RSTA)—Very intelligent surveillance and target acquisition technologies will permit the fusion of data from multiple sensors to provide information needed by the Army commanders on the fluid, complex battlefield of the future. Near-realtime presentation of ground based and airborne radar, optical and human intelligence will provide the needed increases in lethality and survivability. Millimeter wave technology is being pursued to permit a sensor to see and terminal homing missiles and artillery rounds to engage targets through battlefield smoke, fog and dust. Advanced visible and infrared technology is making a major contribution to our ability to passively detect and identify targets at night and under adverse weather conditions. This past year we demonstrated the first uncooled sensor array for night vision. AirLand battlefield environment tactical decision aids will provide information on terrain, weather and battle induced contaminants and intelligence regarding the effectiveness of friendly or threat weapon systems and operations.

- Command, Control and Communications (C3)– Distributed C3 technologies and networks will enhance communications and the reliable distribution of information to all levels of command. Digital burst transmission techniques, millimeter wave and higher frequency spectra, and fiber optics are being pursued to improve jam and intercept resistance and continual information transmission.

- Battlefield Lethality – Self-contained munitions technology will allow munitions after launch to autonomously search, acquire, select and home in on hostile targets. Benefits include increased kills per missile or round fired, greater survivability for the launch vehicle or battery and lower cost per kill. Advances in fiber-optics, infrared, electro-optical, radar, fuse, warhead and delivery system technologies are being pursued. Our Armament Enhancement Initiative Program is focusing technology efforts on defeating the armor threat of the 1990s. Recent accomplishments in battlefield lethality include the successful flight demonstration of the ground launched fiber-optic guided missile (FOG-M).

- Battlefield Sustainment. Logistics R&D is being expanded to improve weapon systems reliability and maintainability, reduce consumption, reduce manpower intensity and reduce operating and supportcost. Expert system technology for helicopter diagnostics and condition monitoring is being demonstrated to reduce the number of inspections and scheduled maintenance tasks by monitoring flight data. The cognitive skills of the expert maintainers and diagnosticians are instantly made available to the lesser experienced maintainer. Our food technology program has demonstrated a light weight mobile combat feeding system for the soldier in the field that provides high nutrition, prepackaged, labor-free hot meals for the unit on the move.

- Soldier and Unit Performance Enhancement. Proper soldier-machine interface is receiving increased emphasis not only in the design and development of our equipment, but also during the concept formulation and technology development stages. Soldier-machine interface technologies will improve training, expand individual capabilities and make it easier to operate sophisticated equipment. Robotics, expert systems and artificial intelligence will reduce the workload, enhance the performance of human operators and reduce the number of required operators. Computer generated imagery and display technology for more realistic mission simulators and embedded training technology are but two of the advanced technologies contributing to rapid training advancements.

Our 6.1 basic research program supports both theoretical and experimental research by Army laboratories, industrial laboratories and over 200 universities. These universities and labs are the birthplace of the emerging, high leverage technologies of the future. This year's budget includes the University Research Initiative (URI) for ten scientific areas vital to our Army of Excellence. This is part of a DoD-wide competitive program initiated in FY86 with U.S. universities. The successes of our Centers of Excellence for Rotary-Wing Aircraft Technology at Georgia Institute of Technology, University of Maryland and Rensselaer Polytechnical Institute prove the mutual benefits of this program to the Army, industry, universities and the nation. The URI program stimulates fundamental research vital to the Army, provides a valuable pool of high technology expertise, speeds the infusion of emerging technologies from academia to industry, promotes a stronger university/Army laboratory interface and produces scientists and engineers educated in disciplines critical to the Army. The URI addresses ten vital technology areas: manufacturing science; reliability and maintainability technology; electro-optics; signal processing and image understanding; advanced propulsion systems; geosciences; fast reaction kinetics; intelligent control systems; high frequency microelectronics; ultra dynamic performance materials; biosystems and biotechnology and advanced construction technology.

# MEDICAL RESEARCH

Together with modern battlefield weapons systems, the soldier must be considered a "System" and, as the operator, is the most vulnerable and critical component in the array of battlefield systems. The Army medical research and development program is geared to address performance degradation factors that could make this system inoperable or cause it to operate at reduced efficiency due to physical, psychological, or disease-related stresses in a variety of climates and hostile environments, both in peacetime and during periods of hostilities.

Many of the normal, daily hazards to the soldier come from sources such as blast overpressure from artillery, combustion fumes from explosions, and radiation from laser, microwave, and radar systems. Army Medical Research addresses these environmental and occupational hazards.

Advances are also being made to aid the soldier in dealing with natural stresses. These include heat, cold, altitude, sleep deprivation, exhaustion, and the psychological strain of the battlefield. Our personnel are more likely to become casualties from infectious diseases that have decimated military forces during past wars than from any manmade weapon system. Exploiting high payoff technological opportunities in development of drugs, vaccines, and devices for the diagnosis, prevention and treatment of communicable diseases is crucial for success in this area. Monoclonal antibody productions, genetic engineering, novel drug delivery systems, immune enhancement and biomicrosensor development are being actively pursued.

Recent advances in biotechnology are being utilized to speed the process of vaccine development. A notable accomplishment in this area was the development of a vaccine against falciparum malaria. This strategy is being applied to develop vaccines against other parasitic diseases to include African sleeping sickness and leishmaniasis. Recombinant DNA and monoclonal antibody techniques are being used to prepare diagnostic reagents field kits for use in rapid identification of BW agents and natural diseases in the field.

Ribavirin, an anti-viral drug was found to have a curative effect against Korean and Argentinian hemorrhagic fever viruses. A recombinant Rift Valley fever vaccine was found to be very effective in animals.

During periods of hostilities, the soldier may be incapacitated or at reduced efficiency due to the effects of chemical, nuclear, or biological weapons. In support of the soldier on the modern battlefield, new techniques in disease prevention, self-treatment, patient management, resuscitation, and decontamination have been and are being developed. The cyanide antidotes, sodium nitrite and sodium thiosulfate were repackaged and included into the chemical treatment set at battalion aid stations. A prototype vital signs and heart rate monitor has been developed; we have completed operational testing on a prototype patient wrap. Development was completed on a prototype individual soldier resuscitator. We also initiated a soldier performance battery testing with pyridostigmine.

Improved treatment of combat casualties requires earlier diagnosis and treatment of hypovolemic shock. In addition to improved resuscitative fluids, drugs that may "buy time" until adequate volume replacement can be effected are under investigation.

Research aimed at reducing mortality and morbidity due to head missile wounds is a high priority. Improved management of burn wounds is sought through improved dressings, skin substitutes, and epithelial growth systems.

Combat medical materiel items being developed include field production of oxygen and medical grade IV water, field medical refrigerator, heated patient liner for the transportation of casualties, and wheeled litter carrier.

Research in the area of combat dentistry currently includes the following major efforts: the development of synthetic, biodegradable implant materials to replace missing facial bone segments that will accelerate wound healing and simplify final surgical reconstruction; completed advanced development and field testing of a computer-aided post-mortem identification (CAPMI) system; sucessfully laboratory tested a second prototype light-weight hand-held field dental x-ray.

Research in stresses to the soldier-operator produced by materiel systems, battlefield environments, and natural environmental extremes has resulted in a data base and performance criteria for acute mountain sickness. We also conducted field testing of the Combat Feeding System, the largest test ever undertaken of a military field feeding system.

Anticipated FY87 efforts include: field testing vaccines such as malaria, Korean and Argentinian hemorrhagic fever viruses, Rift Valley fever virus, salmonella-shigella (dysentery) vaccine and anti-malarial drugs. We plan to test prototypes of on-site oxygen generation systems, resusciatative fluid production systems and a high capacity x-ray system. Other efforts will include work on pharmacological intervention of soldier performance to include jet lag, fatigue and sleep reversal. Futher efforts include: work/rest cycle, family/individual/soldier cohesion, development of artificial skin and a blood preservation system.

Furthermore the following are also planned for FY87: field testing of CAPMI, clinical trials of wound dressings, preparation of sustained time release microencapsulated antibiotics for prevention of wound infection, oral pyridostigmine, production of a patient wrap, a full scale production of chemical warfare agent decontamination resin, and development of a second generation nerve agent pre-treatment and antidotes.

These accomplishments are merely a few of the highlights of an extremely complex and broad research effort encompassing all aspects ofpotential hazards to the soldier, the crucial "system" on the technologically complex modern battlefield.

# STRATEGIC DEFENSE

Since the 23 March 1983, speech by the President in which he announced the goal of eliminating the threat posed by ballistic missiles, a program called the Strategic Defense Initiative (SDI) has been established. The SDI, under the centralized management of the Strategic Defense Initiative Organization (SDIO), Office of the Secretary of Defense, is charged with pursuing technologies for defense against ballistic missiles. Emphasis in the program is being given to non-nuclear weapons for defense. The funds for this critical research program are controlled by SDIO and allocated to the Services for execution on a task basis. The Army portion of the SDI has been in being for more than 25 years and received renewed interest and direction with the formation of the U.S. Army Strategic Defense Command (USASDC) on 1 July 1985. The Commanding General, USASDC, acts as the single point of contact in the Army for SDI matters.

After the Congressionally directed termination of the Army-developed BMD SAFEGUARD system in 1975, the U.S. has not had a deployed BMD SYSTEM. However, a continuing R&D program in BMD technology verification and functional experiments has evolved. It promises new technologies and refined system concepts to provide reduced risk and technically advanced options for consideration for future full-scale development. The potential for highly effective defensive systems has never been greater. New systems concepts possess potential for countering attacking ballistic missiles in all phases of their trajectories. Progress has been dramatic in expanding and advancing the technology base from which these future BMD systems will evolve. As a result, the program is in a position to make substantial contributions to the Strategic Defense Initiative technology efforts.

The Army strategic defense program has been conducting R&D aimed at increasing the capabilities and effectiveness of defensive systems for over 25 years. Because of these efforts, the Army has established a highly experienced BMD organization with an extensive technical data base. The Army is therefore uniquely capable to support the Strategic Defense Initiative through early demonstrations of defense capabilities.

Major program thrusts are aimed at demonstrating system and subsystem concepts and developing the mature technologies necessary to support them. Significant effort will be put into defense definition, experiments of aircraft mounted optical sensor adjuncts, terminal imaging radar, advanced radar discrimination, and nonnuclear kill interceptors. Nonnuclear Kill (NNK) mechanisms both within the atmosphere (Endoatmospheric NNK) and outside the earth's atmosphere (Exoatmospheric NNK) and outside the earth's atmosphere (ExoatmosphericNNK) are the major thrust of the program. In addition, experiments will proceed on a terminal defense radar, command, control communication/battle management (C3/BM) system, and data processor. Advanced technology work, to expand the base from which new systems will evolve, will continue.

on a broad front, including research on directed energy and kinetic energy weapon technologies, advanced sensors, battle management, data processing and discrimination missiles.

Systems concepts being examined include endoatmospheric and exoatmospheric defenses. The integration of these into a multi-tiered defense in depth provides a logical and evolutionary growth path for BMD to a wide range of future options to counter a continued buildup of the Soviet threat in both quantity and quality. These options provide the flexibility required for the various potential BMD missions. For example, a defense in depth could provide protection to critical military and industrial installations and other high value targets. By pursuing a broadly based effort, the BMD program maintains the flexibility to provide defense options for many different applications and thus support the President's goal of eliminating the threat posed by ballistic missiles.

The BMD program also operates the Kwajalein Missile Range (KMR) as a national range. The simultaneous use of KMR for both strategic offensive and defensive program testing provides a unique opportunity to collect realistic data vital to both efforts. The ability of the BMD program to observe and analyze development and operational ICBM firings allows cost savings in the tens of millions of dollars yearly. Kwajalein is the only range in the free world that can accommodate full-scale ICBM tests and provide sophisticated data collection for the terminal and midcourse portions of the trajectory. KMR is a unique national resource, utilized by the Services, NASA and other government agencies.

The Army Strategic Defense Program, through its broadly-based R&D efforts, seeks to develop multi-tiered defense capabilities and conductearly demonstrations of critical defense components. The development of nonnuclear kill systems will continue to receive high priority. The BMD program, by building on the existing infrastructure and emphasizinge volutionary development, is able to accomplish these goals and offer a wide range of options for the defense of the country.

## CLOSE COMBAT

*Frontline troops require close combat systems*

The Close Combat mission area relates to weapons and equipment which are used to bring direct, line-of-sight fire upon the enemy. The soldiers who fill this role are often referred to as "frontline troops" and their job is to close with and destroy the enemy. To do so, they must be well led, well trained, and provided with the equipment that will give them an edge over their adversaries. The next several paragraphs will describe those close combat equipment systems for which we are requesting funds in the FY87 budget.

*The M1 Abrams-Main power of the battlefield*

The main offensive and defensive ground weapon of both the US and Soviet ground armies is the tank. In a combined arms role, tanks can dominate the battlefield, spearheading the offensive, killing other tanks, devastating "soft" targets, and driving through defensive positions with massive momentum. Equally adept on the defensive, the tank provides a ground commander with unequalled capability to counter enemy offensive ground weapon systems. The tank is essential to success on the modern battlefield. The Army's main battle tank, the Abrams, is the most powerful, mobile, and survivable combat vehicle we have ever fielded, and we believe that it can outperform any other tank on the battlefield.

*M1 Abrams*

*Agility*

The agility of a tank is a major element in determining its effectiveness and survivability on the battlefield. A 1500-horsepower turbine engine supplies the Abrams with double the power of its diesel-powered predecessor, the M60. Coupled with an improved suspension system, its agility is unsurpassed by any tank in the world today. Its stabilized sighting system ensures that speed is combined with accurate firepower.

*Accuracy*

Tankers are able to routinely hit 5-foot targets over a mile away while moving rapidly cross-country. This kind of shoot-on-the-move accuracy is made possible by design features of the fire control and improved suspension systems. The gunner puts his sight on the target and finds the range using a laser rangefinder; a computer automatically determines the ballistic data and adjusts the lay of the main gun; the gunner need only squeeze the trigger to hit the target.

*Shooting-On-The-Move*

*Survivability*

The future battlefield will be thick with antitank weapons. Therefore, the Abrams is protected by advanced armor. This, plus its low silhouette and agility, increases its survivability on the battlefield. If the tank is penetrated, a number of revolutionary safety features greatly enhance the survivability of the crew and the vehicle. These include an automatic fire detection and extinguishing system and armored compartments that separate the fuel tanks and main gun ammunition from the crew. The Abrams' passive thermal imaging system allows location of targets at night and through dust, haze, fog, and smoke without disclosing the tank's position. Initial delivery of the product improved M1 the M1A1s began in August 1985. The M1A1 incorporates the German-designed, US-manufactured 120mm smoothbore gun, improved NBC protection system and improved armor. The addition of the 120mm gun will insure that US tanks can keep pace with improvements in Soviet armor expected in the late 1980's and beyond. The major advantages of the 120mm gun system are greater kill capability and growth potential to meet advanced armor threats.

*A proven performer*

The soldiers' appraisal of the M1 can be summed up in one word—winner! They found the M1 Abrams easier to maintain than the M60 tank and able to shoot more accurately while moving cross-country at high speed. The Army has fielded 32 battalion equivalents. A North Carolina National Guard Armored Battalion (a 2d Armored Division round-out battalion) has received its tanks underscoring our commitment to modernize the reserve components. The FY87 budget provides for 840 M1A1 Abrams Tanks. We have produced 3,056 Abrams tanks as of 31 December 1985.

*M60A3—Still a capable tank*

The M60A3, a product improved M60 tank, is still a formidable tank. It is a quality tank that will continue to see service into the 1990's because we cannot afford to replace our entire fleet of M60 series tanks with the Abrams. The M60A3 model incorporates a laser rangefinder and a ballistic computer for accurate ranging and improved fire control solutions, and a thermal sight that gives the crew an improved capability to detect targets in darkness and on an obscured battlefield. In FY87 upgrade of the M60A3 will continue with the incorporation of applique armor and an automatic fire supression system to improve survivability.

M60A3

Bradley Fighting Vehicle

*The Bradley Fighting Vehicles*

The history of modern warfare has vividly demonstrated that tanks are critical to success on the battle-field. Operating independently, however, they are vulnerable to antitank fires from enemy infantry. Therefore, mechanized infantry must be combined with tanks to assure a blend of maneuver forces that will provide the flexibility necessary to defeat any threat. The Bradley Fighting Vehicle is an ideal partner for the Abrams. This vehicle has two configurations, the Infantry Fighting Vehicle (IFV) and the Cavalry Fighting Vehicle (CFV).

The Bradley Fighting Vehicle provides vastly improved cross-country mobility, firepower, and armored protection to the mechanized infantry squad. In intense combat situations, the tank-infantry force must be supported on the move by continuousand accurate fire. The primary weapon of the IFV is a stabilized, dual-fed 25mm automatic cannon. The commander or gunner can instantly select either high explosive or armor-piercing rounds. The high-explosive round can destroy unarmored ground targets out to 2500 meters, while the armor-piercing rounds are capable of penetrating and defeating the Soviet BMP. The two-man turret also has a two-tube TOW missile launcher and a 7.62mm coaxial machinegun. The TOW gives each squad the capability to engage enemy tanks at long range from overwatch (protected) positions.

The IFV has vision blocks, through which members of the squad it transports can view the battlefield and direct fire from their modified M-16 rifles through individual firing ports. This permits continuous observation of, and contact with, the enemy while on the move. Once outside the vehicle, troops can move toward the objective supported by a high volume of firepower from the vehicle's other weapons.

The CFV is identical to the IFV except for minor modifications for crew size and equipment. The CFV carries a five-man scout squad and provides the cross-country mobility and mounted firepower necessary for armored cavalry and battalion scout squads to carry out reconnaissance, security, and economy-of-force operations.

*M2-3 Bradley Fighting Vehicle*

Both the IFV and CFV have an inherent swimming capability and are air transportable in either the C-141 or C-5A aircraft. These fighting vehicles match the highway and cross-country mobility of the Abrams tank. Furthermore, they provide soldiers significant protection from enemy small caliber weapons, heavy machine guns, artillery airbursts and antipersonnel mines. A thermal night sight insures that this potent weapon system maintains its capability during night operations. No fighting vehicle available in the world today matches the all-around capabilities provided by the Bradley.

Bradley Demonstrated all-around capabilities

The first Bradley production vehicle was delivered to the Army in May 1981. Today, we are producing the Bradley at a rate in excess of 50 vehicles per month. The first mechanized infantrybattalion was equipped in March 1983 at Fort Hood, Texas, and the first European battalion was equipped in September 1983. The North Carolina National Guard has also received six CFV's. As of 31 January 1986, 2142 Bradleys have been accepted by the Army. Seventeen battalion equivalents have been fielded. The FY87 budget supports the production of 870 Bradley vehicles in the BFVS-A1 configuration. This vehicle includes the TOW-2 system, a tank killing armament, which allows the Bradley to shoot through obscurants while counteracting jamming.

Like the Abrams tank, the Bradley is a winner in the view of the soldiers who use it. It provides them a capability they have never had on the battlefield before. The Bradley is a superb fighting system today which can be made even better by product improving it like we do all our systems. The Army is currently developing a series of survivability improvements to make it even better.

The M113 family of vehicles continues to serve the Army in a variety of combat, combat support, and combat service support roles. The Army has begun survivability modifications to enhance the capability of this fleet into the 1990's. Improvements include spall suppression liners which decrease the spray of shrapnel in the event of vehicle penetration. Additional improvements are armored external fuel tanks, improvements to the power train and provisions for add-on armor kits to increase protection levels for the crew. The powertrain improvements increase reliability and maintainability while providing the power increase needed to assure adequate agility and mobility on the battlefield.

*M113 Armored Personnel Carrier*

M113

Another variant of the M113 vehicle family is the M577 Command Post Vehicle which provides command and control facilities for both forward maneuver and support forces. It features a raised top deck section that permits stand-up work within the carrier and an auxillary power unit to permit operation with the main engine shut down. The FY87 budget will procure 300 new M577'sagainst existing shortages.

Attack helicopters continue to be a key element of our Army's combat capability. They provide our forces with a highly mobile, long range, day/night lethal antiarmor fire capability, coupled with the anti-materiel, antipersonnel effect of cannon and 2.75-inch rockets. The attack helicopter was first used in combat in Southeast Asia where it proved to be a great asset to our light infantry forces.

*Attack Helicopter's inherent mobility*

Because of its inherent mobility, attack helicopters will play a major role in any situation that requires our forces to react quickly. They can strategically deploy to reinforce Europe or respond to other contingency requirements; they can fly rapidly across a wide front to areas that cannot be reached easily by ground mobile forces and they provide a significant advantage in target-rich environments where exploitation is feasible. In Europe, a ground attack on our forces will be spearheaded by masses of armored vehicles. Soviet doctrine stresses building overwhelming momentum with blitzkrieg-like tactics. Frontages mandate that we concentrate on their main avenue of approach and quickly counter their armored thrusts. No other weapon system offers the combination of high movement rates, freedom of the tyranny of terrain, and long-range point target destruction capability, around the clock, even during adverse weather conditions like that of the attack helicopter.

*AH-64 Attack Helicopter*

The large number of attack helicopters that the Soviets have fielded in recent years shows that their leaders share our belief that the attack helicopter will play a vital role in any future land battle. The importance of attack helicopters, and the recognition of Cobra/TOW performance limitations, led to the development and procurement of the Apache Attack Helicopter (AH-64). The Apache represents a significant increase in performance, firepower, and survivability when compared with its predecessor—the AH-1S Cobra. More important, the Apache provides the Army a mobile, lethal antitank capability that can be quickly deployed worldwide to areas of strategic concern. Apache's ability to operate worldwide over a broad spectrum of environments may be the difference between success or failure.

*Appache Attack Helicopter: An all-environment performer*

The powerful, two-engine Apache has been designed from the start to perform anywhere in the world under the most demanding conditions of altitude and climate. Its agility enables pilots to take advantage of the terrain, vegetation, and even buildings to avoid detection. A target acquisition/designation sight (TADS) and pilot night vision sensor (PNVS) enable the crew to navigate and attack in darkness, bad weather and on an obscured battlefield.

*Survivable*

Apache carries a formidable array of weaponry. The main armament is the Hellfire, a third-generation antiarmor missile. Apache's other armament includes the 30mm chain gun and Hydra 70 multi-purpose submunition rockets, which are lethal against a wide variety of targets and complement the antiarmor Hellfire missiles. The Apache's performance characteristics, coupled with survivability features such as armor protection, redundant controls, and electronic countermeasures equipment, make it one of the most survivable systems on the battlefield. A total of 67 Apaches have been delivered to the Army as of 31 December 1985. Training of pilots and maintenance personnel is underway to support fielding of the first Apache unit during the spring of 1986. The FY87 budget provides for procurement of 144 Apache helicopters at the economic rate of 12 per month.

*Cobra/TOW: Effective but limited*

Like the M60 series tank, the AH-1 Cobra helicopter has been continually upgraded to improve its operational capabilities, safety, and survivability. While these improvements will contribute to its effectiveness and survivability against armor, the Cobra is currently a daytime helicopter with limited aircraft performance capability when operating in a characteristically hot Middle Eastern environment. To correct the night-fighting shortfall, approximately 500 Cobras, will be modified with a Forward-Looking Infrared System (FLIR) to provide a night target engagement capability. The FY87 budget also funds other improvements and continues the Cobra Fleet Life Extension (C-FLEX) program. The C-FLEX program will enable the Cobra to continue in use beyond the year 2000.

*Scout Helicopters*

The use of scout helicopters to seek and select targets enables attack helicopters to conserve fuel and ordnance, and allows the commander to concentrate his antitank capability at critical points. Upon acquiring targets, the scouts position the attack helicopters, determine the distribution of fires, laser designate targets for the Hellfire missile, and coordinate artillery fires throughout the battle area. During the battle, scouts provide real-time battlefield information relating to the enemy situation and targets destroyed.

*Apache with Hellfire*

Additionally, the scout is a responsive system to refine intelligence from other sources and integrate all forms of firepower against the target.

The Army Helicopter Improvement Program (AHIP) upgrades part of the scout fleet into an improved observation helicopter. Engine performance and rotor improvements make the AHIP better able to operate on hot days and at high altitude. The mast-mounted sight incorporates a laser designator and a forward looking, infrared capability for night and adverse weather operations. This mast mounted sight allows the helicopter to remain masked behind the terrain with only the sight exposed. In addition to the employment of conventional artillery the AHIP has the capability of acquiring and designating targets for Copperhead and other Army or Air Force precision guided munitions.

*AH-1S Cobra/TOW*

*Army Helicopter Improvement Program*

The AHIP program, based upon modification of an existing light observation aircraft, complies with Congressional guidance and shows significant savings when compared with a new airframe development program. Advanced procurement funding in FY86 and procurement funds in FY87 will provide for the conversion of 48 aircraft in FY87.

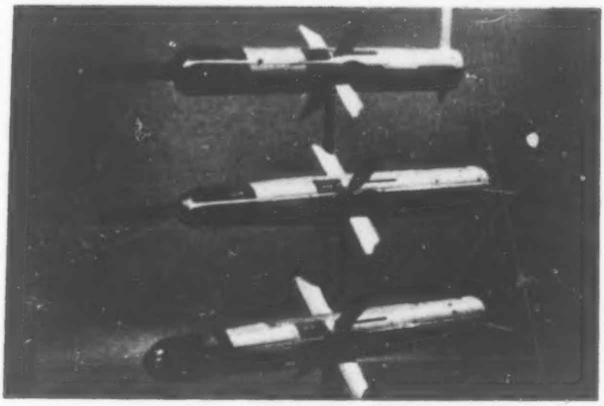
The TOW missile system, which is found on the AH-1S Cobra, the Bradley Vehicles, Improved TOW vehicles, the HMMWV, and with the dismounted infantry, is the most powerful antitank weapon used by ground units. This long-range (3750 meters) antiarmor system is a prime example of evolutionary development. First fielded in the late 1960's, the TOW has been improved to keep pace with the evolving Soviet tank threat. The latest improvement, designated TOW 2, will give the weapon an even more lethal 6-inch warhead, greater speed to reduce vulnerability, and improved guidance and electro-optical countermeasures for an obscured battlefield environment. Deliveries of TOW 2 began in 1983 and it was deployed to Europe in October 1984. Fielding is now complete in Europe, Korea and Panama. FY 87 funds will be used to procure TOW 2 missiles and launcher modifications.

*Army Helicopter Improvement Program*

The Swedish AT4, type classified M136 on 11 Sep 85, will replace the 1958 vintage M72 LAW. The AT4 provides the dismounted soldier with a lightweight, one shot munition that will enable him to effectively engage a variety of hard targets on the battlefield. This proliferable system will not require a dedicated gunner and will be issued to personnel as needed for mission accomplishment. The AT4 allows the soldier to engage and defeat targets at significantly greater ranges with a higher probability of kill than the current M72A3 LAW. The weapon is also being procured by the Marine Corps and the Navy.

*Squad Automatic Weapon*

The Squad Automatic Weapon (SAW) is a lightweight, manportable weapon capable of delivering a heavy volume of effective fire up to a range of 800 meters. It provides increased range, volume of fire, and better penetration than the M16A1 rifle which it replaces as the squad automatic



*TOW-2, Improved TOW, Basic TOW (Top to bottom)*

*Squad Automatic Weapon*

weapon. The fielding of this weapon will provide a significant increase in overall squad firepower.

*Mortars*

The mortar, although an indirect fire weapon, is included in the close combat mission area since it is used by forward combat units. The Army is replacing the present 81mm mortars with an improved 81mm mortar which incorporates a British manufactured mortar barrel and bipod mount and a US base plate and sight. It will fire an improved high-explosive round that will accommodate a multioption fuze and achieve extended range, increased accuracy, and higher lethality. Improved smoke and illumination projectiles are also under development. The FY87 request is for 450 systems. The Army will also replace the aged 4.2 inch mortars with the 120mm mortar. The 120mm mortars will be at the battalion level in mechanized, armored and motorized divisions First unit equipped is expected to occur in 2nd quarter FY87

*Mark 19*

The Mark 19 Mod 3 40mm automatic grenade launcher fires antipersonnel and anti-light-armor grenades to a maximum effective range of 1600 meters The MK19-3 will be used in the main battle area by infantry units, and by combat support and combat service support units to conduct rear area security missions It replaces selected M2 (.50 caliber) and M60 (7.62mm) machineguns and will be mounted on ground mounts and on Army vehicles such as the High Mobility Multi-purpose Wheeled Vehicle (HMMWV)

*Night vision devices will allow battle operations in the dark*

Nightfall will no longer curtail battle activities Because of advanced night vision devices, night will simply mean a slightly altered environment to soldiers in a future war This is possible through the Army's use of two different types of night vision equipment: image intensifiers and forward looking infrared imagers The latter is also referred to as "FLIR" or "thermal imaging"

*Systems incorporate thermal imaging for night activities*

Image intensifiers see in darkness by amplifying the dim starlight and moonlight reflected from an object. The image intensification devices are lightweight and provide excellent resolution while "seeing" in the dark These devices are for the individual soldier as well as the wheeled and tracked combat vehicle The AN/AVS-6 and AN/PVS-5 are night vision goggles for aviators and ground soldiers The night vision device for the M16 and M60 machinegun is the AN/PVS-4 and the AN/TVS-5 is designed for the M2 (.50 cal) machinegun The AN/VVS-2, Drivers Viewer, gives the tracked vehicle driver a greater mobility capability, while driving at night

Another family of night vision devices is thermal imaging By sensing the temperature difference between an object and its surroundings, these devices allow the soldier to "see" through darkness, smoke, haze, fog, and battlefield obscurants to recognize and identify targets The Army systems incorporating thermal technology include a family of manportable systems consisting of the AN/TAS-4A, TOW Night Sight; AN/TAS-5, Dragon Night Tracker, and AN/TAS-6, Night Observation Device Long Range (NODLR) The M60A3 and M1 tanks incorporate the AN/VSG-2 and TIS, respectively, for gunner and commander use The AH-64 APACHE attack helicopter uses the TADS/PNVS for fire control and pilot's night vision The Bradley fighting vehicle also incorporates a FLIR in its integrated sight unit

The Army's technology in night vision devices clearly leads that of Warsaw Pact Nations, however, the gap is closing Therefore, we must continue technology efforts towards developing newer generation devices so that we can use darkness to our advantage on the future battlefield

The Advanced Antitank Weapon System Medium (AAWS-M) will be a manportable weapon employed by dismounted infantry at the platoon level to defeat current and future Soviet advanced armor The system will provide

*Advanced Antitank Weapon System*

a high probability of kill in all realistic battlefield environments and in the presence of electronic/electro-optical countermeasures The AAWS-M, which will replace the DRAGON system, will be developed to address the deficiencies of that system and will possess the growth potential to counter evolving armor threats The AAWS-M will have a weight of no more than 45 pounds and an effective range of 2KM or more under day or night conditions The tactical system will consist of a round (missile and throwaway launch tube) and a reusable command and launch unit (CLU) Increased gunner survivability will be a primary employment consideration The system soft launch capability will enable firing from protected fighting positions, an all-environment sighting/surveillance capability coupled with extended range will enable the targets to be engaged earlier than DRAGON, thereby improving gunner survivability

The next section on fire support mission area discusses how those frontline soldiers are supported

# FIRE SUPPORT

The Fire Support mission area includes those systems that are used primarily to generate indirect firepower. The systems in this mission area include not only conventional, nuclear, and chemical firepower provided by cannons, rockets, and missile systems, but also the target acquisition and fire control elements integral to field artillery systems. This section will address the Army's longest range systems first and then will discuss direct support artillery weapons, fire control, target acquisition systems, and finally ammunition developments.

*Soviets attack in depth*

Soviet doctrine emphasizes the use of echelonment in depth. Warsaw Pact forces attack with successive waves of forces, massing as necessary through the use of mechanized armament systems to achieve victory. We must, therefore, be able to strike early and strike deep with great accuracy and massive firepower. We must also be capable of attacking enemy units up to the forward edge of our own troop positions with concentrated, accurate, and readily available firepower.

The Soviet's early use of their own artillery will make this task even more

*Pershing II*

difficult. Their doctrine stresses the use of concentrated artillery fire in coordination with blitzkrieg like maneuver of troops. The Soviets greatly outnumber us in artillery and have the potential to strike our positions with massive amounts of indirect fires. To preclude this, our own field artillery must be able to neutralize their indirect fire systems through effective counterfire.

*Pershing II achieves surgical accuracy*

The Army's most powerful weapon is the Pershing II, which has more than twice the range of the existing Pershing Ia and far better accuracy. It employs radar area correlation to achieve its pinpoint accuracy. Radar "pictures" of the target area are put into the onboard missile computer prior to launch. As the reentry vehicle approaches the general target area, it takes its own radar "pictures" of the terrain, comparing them to the original. By making course corrections until the two pictures coincide, the missile can achieve surgical accuracy. This permits the use of a relatively small nuclear warhead that reduces collateral damage to the minimum. Pershing II is in production and completed deployment in December 1985.

*Lance strikes in depth*

The Lance missile system, which was fielded in the mid 1970's, is our current system used to attack second-echelon enemy formations and for delivery of short-to-medium range nuclear fires. Lance can deliver a 1000 pound conventional warhead to a target located over 70 kilometers away. Enemy logistics facilities, air defense sites, and communications centers are prime targets for this warhead.

To improve the conventional capability provided by Lance and to eliminate many of its shortcomings, e.g., slow rate of fire, manpower intensity, limited range, etc., a follow-on program called the Army Tactical Missile System (ATACMS) is being pursued for the late 1980's/early 1990's fielding.

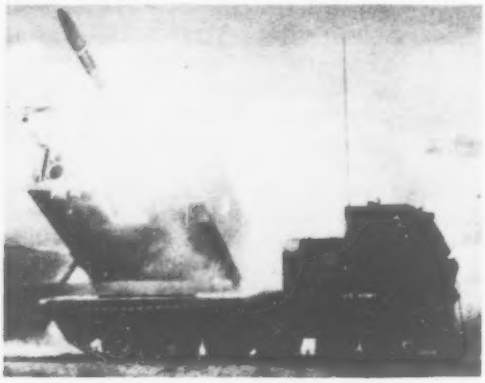
*Army TACMS engages indepth battle areas*

Army TACMS is an improved conventional ballistic missile system that will be used by the corps commander to destroy, delay, or neutralize enemy forces far beyond the range of cannons and rockets. The corps, by slowing down the enemy's ability to reinforce and support the central battle, can overcome the expected unfavorable force ratio. The requirement for Army TACMS also includes the attack of surface-to-surface missile (SSM) transporter erector launchers (TEL) as part of the anti-tactical missile (ATM) mission. Army TACMS will be transported and launched from the Multiple Launch Rocket System (MLRS) launcher. FY87 funds provide for a continuing development program to lead us to an early Initial Operational Capability (IOC).

While we must be prepared for both nuclear and nonnuclear contingencies, our first response capability must be adequate conventional firepower. As enemy units advance, there may be critical periods when large numbers of targets threaten to overwhelm the capacity of tube artillery. When this happens, we must be able to strike deep with great accuracy and massive firepower, as well as be capable of attacking enemy units up to the forward edge of our troop positions with concentrated, responsive fire.

*Multiple Launch Rocket System provides massive and accurate fire power*

The Multiple Launch Rocket System (MLRS) is the system that fills this need. It provides the Army with its first multiple rocket artillery capability since World War II. The MLRS rocket warheads contain a large number of improved conventional submunitions which are dispensed from the rocket high over the target and blanket the area with explosives and fragments. These submunitions are devastating against targets such as air defense sites, artillery positions, and troops in the open. The submunitions are also effective against the thin top armor of tanks and other fighting vehicles. The MLRS will be used against concentrations of enemy vehicles, enemy artillery, and as an air defense suppression means.



*Multiple Launch Rocket System*

The system also has incorporated a number of built in efficiencies. The rockets are sealed in pods for shipment and require no maintenance after leaving the factory. The MLRS tracked carrier vehicle is a derivative of the Bradley Fighting Vehicle and has the same power train and level of armor protection for the crew's protection. Although normally operated by a three man crew, in an emergency one soldier can operate the entire system. Devices on the launcher can determine both location and direction, and an on board computer unit computes fire commands, sets fuzes, and automatically fires the rockets. The vehicle cab is designed so that crew members can remain in the cab during rocket firing. It also has a positive overpressure system to protect the crew in the cab from exhaust gases during launch. The FY87 Budget is for continuation of the fifth year of a five year multiyear contract of this important new system.

*Terminal Guided Warhead*

The MLRS was developed by the US in cooperation with Germany, France, the United Kingdom, and Italy. In conjunction with Germany, France, and the United Kingdom, we are pursuing the development of Terminally Guided Warhead (TGW) submunitions. These submunitions will enable the MLRS to attack hard point targets in excess of 30 kilometers from the launcher. The concept calls for a rocket to fly to the kill zone, where the

*M198 Howitzer*

warhead will dispense multiple submunitions that seek out and destroy enemy hard targets The FY87 budget will provide the continued funding for TGW component development and demonstration

*M198*

The M198, 155mm Towed Howitzer, is the general support artillery for the non-mechanized divisions It is also our newest howitzer It is capable of firing 30 kilometers using a rocket assisted projectile The M198 provides major increases in range and reliability over its predecessors and may be delivered by parachute or carried by a variety of cargo aircraft and the CH-47 helicopter The M198 can fire scatterable mines, nuclear rounds, improved conventional munitions (ICM's), conventional high explosives and Copperhead Although our budget does not contain M198 procurement funds for this fiscal year, our long-range plan forecasts additional procurements beginning in FY88 and continuing through FY91

*M119 for light divisions*

The Army's Light Divisions have a requirement for a lightweight howitzer with increased range and lethality over the existing M102 105mm howitzer The Army has been testing the in production British Light Gun (L119) and in December 1985, type classified it for procurement as the M119 In 1987, the first year of procurement, 64 units will be purchased Compared to the M102's range of 11.5KM, the M119 fires conventional HE to 14.3KM and 19.1KM with a Rocket Assisted Projectile (RAP) which is in development A Dual Purpose Improved Conventional Munition (DPICM) is also being developed for the M119, a munition with a great increase in lethality Under a licensing agreement with the UK, all UK production will occur, to be followed by co-production and then total on-shore U S production The 105mm howitzer is scheduled to begin fielding in FY88

*Improvements are part of overall modernization*

The mechanized and armored portions of our force structure have the M109 self-propelled 155mm howitzer and the M110 8-inch self-propelled howitzer These weapons date back to the 1960's, but have been improved over the intervening years We have extended the range of the 155mm howitzer to 24 kilometers and the range of the 8-inch howitzer to 30 kilometers using rocket-assisted projectiles We are continuing to modify the M109 in order to extend the life of the system to at least the year 2000 In this year's

*M109 Howitzer Improvement Program*

budget request we have asked for continued funding to procure modification kits that will provide increases in survivability and capability

We are also conducting research and development of improvements that will provide additional increases in armament reliability and survivability against NBC attack and counterfire, as well as increased responsiveness and reduced crew fatigue The howitzer improvements are only part of the overall effort leading to modernization of the Artillery System

*G/VLLD*

*Ground/Vehicle Laser Locator Designator*

The Ground/Vehicle Laser Locator Designator (G/VLLD) is used by artillery forward observers. This dual purpose device is used by a forward observer to determine target ranges precisely and to designate targets for laser guided projectiles, missiles, or bombs. The G/VLLD achieved its initial operational capability in 1982. The FY87 budget provides for continued procurement. In our armored and mechanized units the Fire Support Team (FIST) requires a mounted vehicular capability. The new Fire Support Team Vehicle (FISTV) will give the FIST armor protection, mobility, and built in communications which will enable it to operate with fast moving armor, mechanized infantry, and cavalry units, and be responsive to the maneuver commander.

*FISTV Responsive to commanders*

The FISTV represents a combination of new laser improved artillery observer equipment with the proven performance of the M113A2 personnel carrier. The vehicle is very similar in appearance to the Improved TOW Vehicle and incorporates the G/VLLD in an armored, elevated module mounted on an M113A2 chassis. The FISTV is equipped with a north seeking gyro that provides the directional data needed for accurate artillery fire requests. It can operate in hull defilade with only the elevated G/VLLD module exposed, thereby increasing survivability. The FY87 funding provides for continued procurement of FISTV Modification Kits. The Army plans to convert 178 M113's to FISTV's this year.

The first vehicles were fielded to the 24th Infantry Division in August 1985. The effective management of the enhanced capability we have been describing is an important responsibility of the Field Artillery. Specifically, our artillerymen have the "fire support mission" for the collective employment of mortars, field artillery, air support, naval gunfire, and other lethal and non-lethal (smoke, illumination) attack systems in support of combat operations. To accomplish this mission, fully automated support for planning, coordination, control, and execution of close support, counterfire, interdiction, and air suppression fires is required to maximize our combat power.

*Fire Support Team Vehicle (FISTV)*

*TACFIRE: Severely limited for tomorrow's battlefield*

Our Field Artillery Tactical Fire Direction System (TACFIRE), as currently fielded, represents first generation technology that provides automated data processing of technical fire control data, selection of munitions and volume of fire for enhanced target accuracy. However, the requirements for a total fire support package that provides (1) development of targets and delivery of fires, (2) coordination and control of fires and fire support assets, and (3) planning for future operations represent severe limitations for TACFIRE on tomorrow's battlefield. In essence, TACFIRE will not meet the data processing needs of the fire support system for the 1990's and beyond. It also is not economically smart to produce TACFIRE spare parts by mid 1990 because of outdated technology. TACFIRE's replacement, The Advanced Field Artillery Tactical Data System (AFATDS), will significantly broaden and modernize the US Army fire support command, control, and coordination systems. The AFATDS will expand the TACFIRE capabilities with no increase in personnel requirements and will provide automated support for the Fire Support Control Segment of the Army Command and Control System (ACCS) during the 1990-2010 timeframe. Compatibility and interoperability will be provided with all existing and planned US Army Field Artillery Systems to include sensor systems, related NATO systems from the United Kingdom (BATES) and the Federal Republic of Germany (ALDER), the Marine Integrated Fire and Air Support System (MIFASS), and other Functional Control Segment Systems in the command and control architecture.

*AFATDS: Expanded automated capabilities*

The AFATDS will retain selected systems of the present TACFIRE for total system integration. For example, the related technical system which provides firing data to each individual weapon will be retained. The Fire Support Team and Forward Observer Digital Message Devices will continue to be the "forward entry devices" in AFATDS and are "not" part of the AFATDS funding program.

Lastly, AFATDS represents the Army's first automated program that is truly software driven. Specifically, prior to any final hardware consideration, user requirements must be accurately defined and then translated, through software development, into a DOD higher order level language (Ada). Once the user software is written, then the hardware will be selected. This approach ensures users satisfaction: it maximizes detailed functional definition of the fire support, command, control and coordination requirement; it provides a basis for a market survey for procuring hardware components that is driven by the user requirements.

Target acquisition within the fire support mission area is of equal importance to fire delivery and control systems. The Firefinder system, consisting of AN/TPQ-36 mortar-locating radar and AN/TPQ-37 artillery locating radar, provides our soldiers the ability to automatically detect and locate enemy batteries in realtime and to attack them with timely and accurate counterbattery fire. The final procurement requests for Firefinder were FY81 (AN/TPQ-36) and FY83 (AN/TPQ-37), with the last units scheduled for delivery to the Army from these buys in July 1986 (AN/TPQ-36) and March 1987 (AN/TPQ-37). Plans project completion of fielding in 1988.

The effective use of field artillery weapons depends upon accurate location, direction, and estimates of the influence of the atmosphere on artillery projectiles, rockets, and missiles as they travel to their targets. We now have automated systems to provide these data.

*Artillery survey workload reduced*

The Position and Azimuth Determining System (PADS) is an automated, self-contained inertial surveying system which provides the field artillery with a secure, all-weather, day/night means for rapid survey control. Surveys that normally take the conventional five-man survey party 12 hours can now be accomplished by a two-man PADS party in less than two hours. The FY87 request will purchase 107 systems which will add to the 360 systems already procured.

*Improved accuracy via timely meteorological data*

The new Meteorological Data System (MDS) will insure that artillery fires are corrected for changing atmospheric conditions. This is significant since greater ranges of artillery projectiles will cause them to be exposed to atmospheric effects for increased periods of time. Reliable data are also required on how weather will affect electronic warfare and battlefield obscurants employed by the enemy. In a "dirty battlefield" environment, where anything from a severe storm to chemical or nuclear conditions may prevail, we must have timely meteorological data. The MDS will accurately measure the atmospheric variations and automatically transmit those variations to TACFIRE and other automated systems that compute artillery firing commands.

*Ammunition stabilization provides warfare capability*

Our ammunition request provides for increased readiness by buying more rounds for artillery for essential modernization by procuring smart munitions such as Copperhead, and for improved sustainability through modernizing old production facilities and increasing explosives and propellants production capability. Each component of the ammunition budget responds to a deficiency in readiness, modernization, or sustainability. The stabilization of the ammunition account is key to providing the warfighting capability we need. Within the Army budget, field artillery ammunition has been allotted the largest portion of our resources for munitions procurement. Major items in this category are 8-inch and 155mm Improved Conventional Munitions, 155mm Area Denial Artillery Munitions and Remote Antiarmor mine system projectiles.

*Munitions R&D*

Opportunities exist for making our weapons more effective through the use of modern munitions and advanced guidance systems. By making greater use of these technologies we can achieve a significant increase in our conventional capability in a cost-effective and timely fashion. The munitions research and development programs cover all types of conventional munitions from exploratory development through engineering development. Major areas include: technical base programs for large caliber munitions development and ballistics technology work applicable to all systems; development of modernized ammunition for the 105mm howitzers; field artillery munitions such as the Sense and Destroy Armor munition—a top attack, antiarmor submunition employing improved sensing for broad application to weapon systems such as the MLRS and 155mm howitzer; and numerous smaller projects for the development of fuzes and propellants. The FY87 request will allow the Army to continue this critical research and development area.

*Copperhead. Dramatic increase in single-shot kill probability*

A successful product of munitions research and development is the precision guided projectile known as Copperhead. Until the advent of Copperhead, the field artilleryman faced the statistical probability of wearing out his gun tube before hitting a moving tank. This laser-guided 155mm howitzer projectile changes those odds dramatically. Copperhead is the only deployed field artillery munition with the ability to yield a high probability first round kill against moving hard point targets.

*Copperhead*

*Field Artillery Ammunition Support Vehicle (FAASV)*

Copperhead is fired from existing 155mm howitzers. It uses a built-in, semiactive laser seeker which makes it possible for the round to destroy stationary or moving armored and other high value targets, at ranges up to 16 kilometers, with a high single shot kill probability. As the projectile descends toward the intended target, its laser seeker searches for and acquires the reflections of a laser beam. This beam can be projected onto the target by G/VLLD, FISTV, AHIP or Apache helicopters or by a remotely piloted vehicle. The projectile corrects its course through the use of its fins as it "homes" to the laser spot on the target.

Copperhead has been in production since 1981 with over 15,745 rounds produced through FY85. Since July 1982, Copperhead has demonstrated better than 80% reliability. FY87 funding will be used to maintain production at efficient rate while continuing to build up our war reserve inventory.

*FAASV*

As a part of our modernization effort, we are also looking at improvements in ammunition hauling, handling, and survivability. In FY83 we initiated procurement of the Field Artillery Ammunition Support Vehicle (FAASV), which is equal in mobility to the self-propelled howitzers in our inventory and provides armored protection for both crew and ammunition. FAASV is being procured for deployment in Europe, Korea and select CONUS units. The FY87 request will add 141 FAASVs to the Army inventory.

# AIR DEFENSE

The Army's Air Defense mission area includes those activities involved with the detection and engagement of the enemy air threat with ground-to-air gun and missile systems, in coordination with the other combined arms and Air Force interceptor aircraft.

*Soviet air threat*

Without adequate air defense coverage, ground combat elements, supply lines, command centers, Air Force strike bases and other high-value targets are exposed to destruction by fixed-wing and rotary-wing attack aircraft. Warsaw Pact forces have over 3,600 combat aircraft in Central Europe, including bombers, fighters, and helicopters. Quality and quantity are on the rise. Ground attack aircraft such as Flogger, Fencer, and a new production ground support fighter, combined with the HIND and HAVOC attack helicopters pose a deadly threat to armor and mechanized forces. In addition to the aircraft threat, there is an increasing threat from the growing numbers and types of tactical missiles and air-launched missiles.

*Air defense modernization*

For many years, short range air defense was provided by Redeye, Vulcan and Chaparral with medium to high altitude air defense provided by HAWK and Nike-Hercules. The Army's current air defense modernization program provides a new mix of systems that will be effective against the growing air threat through the 1990's.

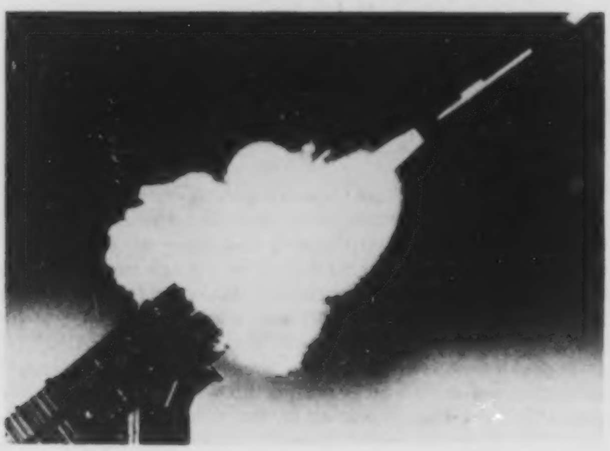
*Patriot: A key system*

In future wars, we can expect to experience saturation raids by large numbers of sophisticated aircraft employing intense electronic countermeasures. In response to this, we are fielding Patriot as a replacement to Nike-Hercules and improving the HAWK missile system.

One of the main shortcomings of Nike-Hercules, which was in the force from 1958 to 1985, was that a battery could only engage one target at a time. The operator had to wait until the missile intercepted the target before firing another missile. Patriot, on the other hand, can attack and destroy several enemy targets while simultaneously tracking other targets.

*Reduced Manpower*

Due to its advanced technology, Patriot is operated with fewer soldiers than its predecessors. Each Patriot launching station contains four ready-to-fire missiles. The missiles, which are sealed in canisters that serve as both shipping containers and launcher tubes, require no field maintenance. Each Patriot battery contains up to eight trailer-mounted launchers that can be



Patriot

I HAWK

widely dispersed. Communication with the Engagement Control Station is made via secure data link.

*Multiple engagement capabilities*

Enemy targets can be tracked and prioritized for destruction through the interaction of Patriot's radar and computer. The radar can guide several missiles at the same time, updating priorities as threat aircraft are engaged. Patriot employs a new guidance concept called Track-Via-Missile. As the missile reaches the area of an enemy aircraft, it informs the radar where it is in relation to the target. A computer then makes calculations and directs the missile on a path that insures a kill. Operating modes vary from manual mode to fully automatic mode. The system's two operators always retain full override capability over computer decisions. The Patriot system is currently in production and is being adopted by our NATO allies. The first fully trained and operational battalion was deployed to Europe in early 1985. The second battalion was deployed in September 1985. The FY 87 budget will support the procurement of additional fire units and the continued fielding of the system.

*New Guidance concept*

The mainstay of the Army's low to medium altitude air defense is the HAWK missile system. Although Patriot will replace some HAWK units, the HAWK force will be retained indefinitely. Ongoing and planned product improvements will upgrade Hawk performance to meet the projected threat through the 1990's. HAWK will have simultaneous engagement capability against close-in saturation attackers, increased detection range, improved reliability, and greater effectiveness against jamming. Twenty-two foreign countries have the system, and procurement interest has been expressed by several others. Part of this worldwide acceptance can be attributed to HAWK's performance in the 1973 Mideast War, where, in its basic configuration, it destroyed more than 20 MiG's and other aircraft. The FY87 budget will continue the product improvement program and will procure replacement rocket motors.

*I-HAWK Upgraded and reliable*

The Army-led, Antitactical Missile (ATM) program began in FY83 to develop counters to the growing tactical surface-to- surface missile threat. The program consists of concurrent near-term to long-term approaches to solve counterforce, terminal defense, and battle management problems. Near-term efforts upgrade existing air defense systems to field an early point terminal defense capability against conventional tactical missiles. Mid-term efforts focus on development of counterforce and anti-cruise missile capabilities. The full solution will include both active and passive countermeasures, and will require a combination of systems, including Army TACMS and current Army air defense systems as well as possible new systems, sensors and battle management capability. FY87 funds will provide for research and development work in threat vulnerability, counterforce requirements and terminal defense capability.

The Army is committed, as a top priority, to solve the critical shortfall in air defense for our forward maneuver elements created by the SGT YORK program termination. A Forward Area Air Defense Working Group (FAADWG) has developed a Counter Air Concept using air defense artillery, the other combined arms and the U. S. Air Force to counter the growing air threat. The FAADWG identified an air defense program that integrates weapon systems, sensors and command, control and communications architecture into a system optimized to counter the entire spectrum of the air threat. The FAAD program is a system of major subsystems consisting of a command, control and intelligence subsystem; a non-line of sight weapon; line of sight weapons for the forward and rear of the division; and combined arms initiatives including air-to-air Stinger, improved tank ammunition and potential improvements to the Bradley Fighting Vehicle gun and fire control. Combinations of available air defense weapons and new technologies are being carefully looked at to provide the needed forward air defense. A final list of candidates will be identified and evaluated in FY86/FY87 FY87 funding is essential to the rapid fielding of this integrated air defense program

The first major element and keystone of the FAAD system is a modern command, control, and intelligence subsystem which will integrate forward air defense weapons into a quick reacting, comprehensive, and lethal arsenal The Forward Area Air Defense Command and Control and Intelligence (FAAD C2I) subsystem (formerly SHORAD C2) is being developed to provide maximum effectiveness from our forward area air defense weapons This C2I effort focuses on increasing the probability of successful engagement of hostile targets by insuring rapid, timely acquisition and dissemination of information on the air combat situation

The present forward area air defense method of accomplishing command and control is totally manual Weapons control information and sensor data from Air Force and high to medium altitude air defense systems is provided to forward area air defense weapons via voice communications. This information is received at a central control facility at the forward area battalion where it is manually filtered, plotted and retransmitted by voice to the appropriate air defense and ground combat elements. This method is time consuming and limits the probability of successful air defense operations

The FAAD C2I development will automate and streamline this process to enable us to successfully engage the air threat within the division airspace Computer processors, graphic displays, control terminals and data links will replace most human actions and voice communications The new subsystem will provide forward area gunners and commanders with the required data quickly and simply and with responsive, flexible, less restrictive weapons controls The FY87 funds continue full-scale engineering development of the switching architecture and selection of the ground sensor that is planned to begin in FY86 FY87 will also continue concept development for an aerial sensor

*Tri-service development of "friend or foe" identification system*

The intelligence part of FAAD C2I includes the sorting of friendly and hostile aircraft during aerial combat The ability to positively identify hostile aircraft remains a significant limitation to our air defense forces, particularly for short range air defense weapons which are currently limited to visual aircraft identification and identification friend or foe localized to individual weapons. In the future we expect to be able to operate beyond visual range through our weapons improvement and acquisition programs Our efforts are focused on noncooperative identification of both hostile and friendly aircraft Several of these have shown excellent potential in early demonstrations We are making limited improvements in our current cooperative friendly identification systems and participating in tri-service development of a new cooperative friendly identification system for selected air defense systems

Improved positive hostile and friendly identification capabilities combined with improved, automated command and control capabilities will maximize the effectiveness of our air defense forces FY87 funding continues development and testing of improved identification capabilities

The second subsystem in the Forward Area Air Defense System is the Non-line-of-sight weapon The weapon is intended to be employed in defilade behind the FLOT and out of range of enemy direct fire systems This subsystem, will give the Army Air Defense the capability to kill helicopters either hovering behind mask or on the ground The Fiber Optic Guided Missile (FOG-M) is a candidate for this mission The FOG-M is a precision guided missile which uses a fiber optic cable to transmit seeker images to the control vehicle and guidance commands to the missile The weapon is a relatively mature system which has been developed largely by the Army's Missile Command Alternative concepts for the Non-line-of-sight weapon including a ground launched version of the Advanced Medium Range Air-to-air missile (AMRAAM) are also being investigated FY87 funding is critical to the early fielding of this part of the Forward Area Air Defense system

The third component of the FAAD are Line-of-sight-forward weapons which will be used in the close combat zone of both light and heavy forces These weapons are designed to kill or suppress enemy fixed wing and exposed rotary wing aircraft A gun/missile mix is contemplated to optimize the strength of both weapon types In general guns are more cost effective and provide quick reaction high volume fire against the close-in targets Missiles are more effective against the longer range targets A request for information has already been released to industry to assist in the preparation of material requirements for the heavy division Because there are numerous weapons which could potentially perform the LOS-F mission an IOC as early as 1989 is conceivable However, this is predicated on FY87 funding

The fourth element of the FAAD system is the Line-of- sight-rear weapon better known as Pedestal Mounted Stinger This weapon uses the manportable Stinger missile fired from a fire unit mounted on a High Mobility Multipurpose Wheeled Vehicle (HMMWV) and will provide defense for the rear area of the division Pedestal Mounted Stinger will be procured in FY87 as a non-developmental item based on an FY86/87 evaluation of candidates

Until the FAAD system is fielded the Army will rely on Stinger, Chaparral, and Vulcan to perform forward air defense

*STINGER*

Stinger is the Army's manportable air defense missile system It provides air defense protection for forward deployed ground combat units Although Pedestal Mounted Stinger will eventually replace most MANPADS teams, Stinger will continue to be used in its shoulder fired configuration when required Stinger was developed to replace the aging Redeye system, which was first fielded in the mid-1960's and had limitations when matched against the current and projected enemy air threat Stinger was deployed to active Army units in Europe in February 1981

Stinger overcomes many of Redeye's shortcomings with improved range and maneuverability, the ability to attack much faster targets, and, most

*STINGER*

*Chaparral*

important, the ability to attack aircraft from any angle. The missile uses a passive infrared seeker. A proportional navigation system enables the Stinger to fly an intercept course to the target. The high-explosive warhead is designed to penetrate the aircraft before exploding in order to insure a kill. These capabilities provide an enormous advantage over the Redeye system, which is a "revenge" or tail-chase system only.

*STINGER POST*

Stinger was designed with built in growth potential. An improved Stinger seeker, Stinger POST, completed development and a production contract was signed in FY83. This seeker improves Stinger performance in a countermeasure environment. Development of the Reprogrammable Microprocessor (RMP) for the missile began in September 1984. FY87 funding will continue the production of Stinger POST (RMP).

Chaparral was first fielded in 1969. It will remain in the active inventory through the 1990's. Chaparral is also being provided to the Army National

*Chaparral Cost effective and continually improved*

Guard as part of their modernization program with the first battalion fielded in 1985. To keep Chaparral current against the threat's countermeasure capability, a new seeker using Rosette Scan Seeker (RSS) technology started production in FY86 with initial facilitization. The first production buy of new seekers will occur in FY87.

Improvements fielded to date include an improved infrared guidance which provides a forward engagement capability, an Identification Friend or Foe (IFF) System to assist the gunner in identifying friendly aircraft, a smokeless rocket motor that increases survivability by reducing the visible smoke trail when the missile is launched, and a Forward Looking Infrared (FLIR) night sight for improved adverse weather and night target acquisition. Future improvements include adding other modifications to improve system performance, reliability and NBC protection.

*PIVADS improves tracking and aiming capabilities*

The Product Improved Vulcan Air Defense System (PIVADS) was developed to improve tracking and gun pointing accuracies and increase maintainability and availability of the current 20mm Vulcan air defense gun to provide an interim capability. Improvements include the replacement of the present disturbed reticle by a director type sight, the replacement of the analog computer with digital fire control electronics, modification of azimuth and elevation systems to reduce backlash and incorporation of built-in-test equipment. A contract has been signed for 285 PIVADS kits and modification is expected to begin in early 1987.

*Product Improved Vulcan*

## COMBAT SUPPORT

We are well acquainted with the Soviet employment of massed armor and the formidable threat it poses to our forces. Minefields and other obstacles which are tied to natural terrain features and integrated into the battle plan serve as a significant combat multiplier. Properly integrated minefields and obstacles serve to slow the rate of movement of mechanized forces thus enhancing the effectiveness of our direct and indirect fire systems. They also serve to force the threat to alter his tactical maneuver plans and force the employment of time and resource-intensive breaching systems. The formations become compressed, thus providing greater vulnerability to our armor killing weapons systems. Should the enemy attempt to simply run through the minefields, he will pay a heavy price in tanks. Our modern mine systems have significantly improved lethality. Finally, attempts to avoid the mined area require modification of his maneuver plans at the Operational level. Again, his maneuver rate is slowed and may well force him into other preselected kill zones, disadvantageous terrain or to adopt other less desirable options such as dismounted maneuver.

*Minefields help deal with massed armor*

On the fluid, rapidly changing battlefield of the future, it is imperative that minefields be emplaced as the ebb and flow of the battle dictates. In the past, the emplacement of mines was a slow, laborious and logistically intensive process and the mines had to be emplaced long before the enemy commanders intentions became clear. Our new Family of Scatterable Mines (FASCAM) changes this situation. Our new delivery capabilities significantly improve emplacement time and provide for a more flexible response to changing tactical situations. Additionally, we have attained a new capability with these systems. We can now employ mines in rear area on key targets such as artillery units, Command and Control centers, logistic complexes, concentrations of armor and routes which may or are being used by reinforcing or counter attacking units.

The Remote Anti-Armor Mine (RAAM) and the Area Denial Artillery Munition (ADAM) are 155mm artillery delivered mines and are in production. We will continue to provide for RAAM and ADAM procurement in FY87.

The Volcano mine dispensing system will begin procurement in 1987. Volcano is a rapid mine dispensing system with mines loaded into mortar-tube-like canisters which are placed in common dispenser racks for helicopter and ground vehicle use. Volcano initially provides for the urgent need for rapid employment of large tactical minefields in the light forces. In the outyears, the Volcano ground system will replace the GEMSS in heavy forces. The Modular Pack Mine System (MOPMS) will begin production in 1988. The MOPMS is a foot-locker sized module containing 21 mines. The MOPMS replaces the heavy and bulky conventional mines now used as a basic load in combat arms units and will also be used in special mining situations such as closing lanes and gaps in large tactical minefields. MOPMS mines are explosively deployed from the module when a threat arises. Otherwise, the module is retrieved for future use.

The other side of the Mine Warfare picture is our need for countermine equipment. The threat has learned the historical value of mines well and is prepared for the employment of mines during all phases of the battle. We can expect him to fully exploit his extensive mining capability. Our combat units require versatile and effective countermine systems to provide the freedom of maneuver necessary in the AirLand Battle. We are far from having a satisfactory countermine capability in the field, while the Soviets are well equipped in this critical area. Continued procurement of several key countermine systems is supported in the FY 87 budget. The Mine Clearing Line Charge (MICLIC) is an explosive line change which clears a path 8 meters wide and 100 meters long through deliberately placed minefields. The mine clearing roller and plow systems which are mounted on tanks provide flexible and effective breaching equipment in nearly all terrain and weather conditions for the numerous hastily emplaced minefields we will encounter.

As key members of the Combined Arms Team, engineers have the responsibility for providing specialized support to ensure the mobility, countermobility and survivability of the maneuver elements. In the lethal environment of the main battle area, the combat support role of the engineers greatly increases the combat effectiveness of our fighting forces by providing terrain reinforcement, construction of fighting positions and obstacles, breaching barriers, clearing obstacles and preparing bridge crossing sites. Today, this mission is even more critical as the battlefield becomes increasingly mobile.

*Armored combat earthmover*

The M9 Armored Combat Earthmover (ACE) is uniquely capable of accomplishing mobility, countermobility, and survivability tasks in the forward area of the battlefield. The M9 has the speed and all terrain mobility to move with the combat force and provide critical support when and where needed. The M9 offers armor protection against artillery fragments and light direct fire weapons as well as operator protection against chemical and biological agents. The M9 is air transportable and air dropable. It can swim, dig, bulldoze, haul, and move with the flow of the battle. The M9 is an essential element of the combined arms team on the highly lethal and mobile AirLand Battlefield.

*Armored Combat Earthmover*

Chemical warfare may very well be the Army's most vulnerable area in the 1980's. Even though the US is formally committed to the policy of "no first use" of lethal or incapacitating chemical agents by adherence to the Geneva Protocol of 1925 and seeks a complete and verifiable ban of lethal chemical weapons, the threat to our forces is high. Today, US forces are facing a chemical threat from an adversary that is the best prepared nation in the world in the use of chemical warfare. Without question, the Soviet Union possesses a formidable offensive capability to wage chemical warfare for an extended period and their leadership continues to devote significant resources to research, development, and procurement of more advanced chemical weapons and equipment. They also have a large and well equipped dedicated chemical force. All units within their armies train extensively for chemical warfare.

*Chemical threat*

Given the disparity between US and Soviet chemical warfare capabilities and evidence of Soviet use of chemical warfare directly or through surrogates, we must promptly modernize our own retaliatory capability. The US currently has a limited stockpile of chemical munitions. All of these munitions are of the unitary design, that is, they contain the actual agent in its final form. These munitions are all over 16 years old, and they are costly to store, maintain in a usable status, and transport in a safe manner. Additionally, the stockpile is composed of weapons and agents that are inadequate and in some cases inappropriate for the modern battlefield. The best option for developing and insuring a credible retaliatory stockpile in support of the national policy of deterrence is binary modernization. The binary concept uses two separated nonlethal chemical components that combine during the flight to the target to form a lethal chemical agent. In addition to the added safety and flexibility afforded by binary munitions during production, storage, and movement, binary modernization will allow us to update weapon and agent mix. An R&D effort is underway to apply binary technology to rocket warheads.

*Stockpile—Aging and inappropriate*

*Binary concept*

The Congress, recognizing the need to modernize the chemical weapons stockpile, appropriated $23.15 million in FY81 for construction and facilitization of the Integrated Binary Production Facility at Pine Bluff Arsenal, Arkansas, to allow for future production of the 155mm GB-2 (nonpersistent) artillery round. Initial construction began in October 1981, and was completed in December 1984. The Army FY87 program includes funds for procurement of 155mm projectiles. Also, the Army ammunition production base in the FY86 program provides for facilities to produce Bigeye Bombs in support of Navy and Air Force procurements.

*Chemical protection equipment*

In addition to modernizing the chemical weapons stockpile, we must continue the procurement of chemical protective equipment in FY87 to improve the ability of our forces to survive an initial chemical attack. More procurement, research, and development are required before we can sustain combat operations in a chemically and biologically contaminated environment. A new protective mask providing improved protection and a simplified collective protection system for use by tactical units will continue to be procured in FY 87. Also, collective protection systems will continue to be integrated into our command, control and communications systems and combat vehicles.

The FY87 chemical-biological program continues our efforts with universities and industry to broaden the technology base required to support materiel needs and to develop improved chemical-biological defense materiel. Development will be completed on numerous collective protection equipment for shelters, vans, and vehicles. Chemical- biological agent detection and alarms development will continue on a remote sensing alarm, an automatic chemical agent detector and alarm, and an automatic liquid agent alarm. Development of a mechanized NBC reconnaissance vehicle was initiated in FY 85. Work will also continue on improved decontamination systems including non-aqueous decontamination systems for tactical vehicles and equipment, and a dual purpose system that will be capable of making smoke for battlefield obscuration decontaminating equipment exposed to chemical-biological agents.

Nuclear artillery projectiles have provided part of the US nuclear deterrent for the past 30 years. Currently fielded nuclear artillery projectiles, which incorporate 1950's era technology, must be replaced to assure continued reliability and effectiveness. Modernization programs are underway. We are currently completing procurement of the 8-inch nuclear artillery projectile and development of the improved 155mm nuclear projectile is continuing. These nuclear artillery projectile programs will provide a Short-Range Nuclear Force (SNF) that will continue to provide a credible nuclear deterrent by assuring the collective survivability of NATO SNF and enhancing the survivability of our conventional firepower.

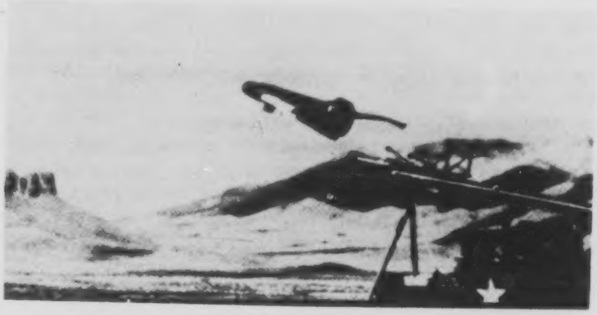
*Deep reconnaissance capabilities*

Today's battlefield requires the commander to be able to look over the next hill out to 300 kilometers deep into the enemy's rear. The commander must be able to acquire data necessary to assess the situation, target a threat force and execute real time operations continuously and simultaneously to interdict threat forces. Unmanned aerial vehicles (UAVs) have the potential to improve the commander's ability to accomplish these tasks. UAVs have the capability to fulfill important battlefield functions: target designation and artillery adjustment; reconnaissance, surveillance, and target acquisition; attack; command, control and communications; air defense early warning; psychological operations; deception and provide meteorological data. Based on the combat-oriented functions, the Army has defined three categories for its family of UAVs: TADARS, General Purpose and Expendable. The Army has defined two current members of the UAV family: the general purpose Corps Intelligence Electronic Warfare (IEW) UAV and TADARS Aquila.

The Army has defined the requirements and a non-development item (NDI) acquisition approach for the Corps IEW UAV, which will be started in FY86 and FY87.

*RPV fills need for timely intelligence*

The Aquila is a militarized system designed to perform target designation, artillery adjustment and laser designation in a high intensity combat electronic warfare environment. The Aquila can fly above key enemy zones in order to gain required data when the defensive strength of the enemy is likely to make manned reconnaissance extremely risky.



*RPV*

The Aquila Full Scale Development (FSD) flight testing started in July 1982. Since then more than 278 flights have been flown with an overall success rate of 92%. The system has experienced technical performance problems. In recent tests, paid for by the contractor, launch, recovery, navigation, telemetry of TV video, jinking, 3-hour endurance, long-range hand-off between ground control stations and laser designation for Copperhead against both stationary and moving targets have all been successfully demonstrated. FY86 RDTE funds will support continuation of developmental and operational tests, continuation of development of the FLIR night vision sensor. FY87 RDTE funds will complete operational testing of Aquila and continue FLIR development. Aquila procurement will begin in FY87 with acquisition of an increment of the training base.

*Joint Tactical Fusion Program*

Modern sensor systems are capable of providing massive volumes of raw intelligence data. In order to be of use to the tactical commander, the collected data must be correlated, integrated, and interpreted with minimal delay. The manual processes now employed in the analysis of tactical intelligence information are inadequate to cope with the volume of collected data in sufficient time to satisfy the commander's needs. This is particularly true in an AirLand Battle, Deep Attack environment, where effective employment of new weapons systems depends on timely and accurate information on enemy activity. The Joint Tactical Fusion Program will remedy this situation through the introduction of automated tactical intelligence fusion systems for the Army and Air Force. The Army system, the All Source Analysis System (ASAS), will provide automated assistance to intelligence processing (fusion) and will also support related areas such as target development, collection and mission management of intelligence and electronic warfare systems, and operations security. The Enemy Situation Correlation Element (ENSCE) will perform similar functions for the Air Force and is being developed concurrently with the All Source Analysis System. Maximum commonality in hardware and software is planned between the Army and Air Force systems to ensure that the ground and air commanders share a common perception of the enemy situation. Current plans call for fielding of baseline fusion systems beginning in the mid- 1980's. These systems will undergo evolutionary development leading to the fielding of objective systems in the early 1990s.FY87 RDTE dollars will complete the design of the large intelligence processing and communications interface modules, type classify the analyst workstation, deliver intelligence processing software for PACAF/USAFE computers and develop the first software release ASAS/ENSCE. FY87 OPA dollars will procure limited capability configuration ASAS for the USA Intelligence School, and two divisions.

*JOINT STARS permits quick reaction battlefield management*

The Joint Surveillance and Target Attack Radar System (JOINT STARS) will provide wide area surveillance of the battlefield. It will have both a moving and a fixed target capability permitting detection and location of targets such as fixed and moving vehicles, command posts, assembly areas, and low-flying helicopters and fixed-wing aircraft. JOINT STARS will broadcast simultaneously to multiple ground stations at division and corps, and will be integrated with the All-Source Analysis Center and the Advanced Field Artillery Tactical Data System to provide both battlefield management and quick- reaction, realtime targeting. Operational effectiveness will be enhanced by cueing from other sensors. In FY87 the Army will provide the initial ground station modules for fielding to Europe.

*Offensive electronic warfare*

Offensive electronic warfare operations are calculated to disrupt enemy command, control, and communications capa- bilities. Every unit is tied by an electronic apron string to its next higher echelon. Disrupting the Soviets' communications network by means of electronic warfare may be a key means of slowing a Warsaw Pact attack by precluding the timely massing of forces and thereby making it vulnerable to eventual defeat. The commander of a force needs to know what the enemy is doing. One way he can get this information is by intercepting and locating enemy emitters. Army systems to provide location and intercept of communications and radar emitters are mounted in aircraft and in wheeled or tracked vehicles. TRAILBLAZER and TEAMPACK systems, which are currently being fielded, are ground-based systems whose targets are, respectively, communications and radar signals. Fielded airborne systems are GUARDRAIL and QUICKLOOK which are being upgraded through product improvements.

*Guardrail*

*Quick Look II*

Guardrail V is a combined airborne sensor and ground processing facility communication intelligence system with proven ability to provide near-realtime data on the location of enemy electronic emitters. Guardrail, in the RU-21H platform, has some limitations such as an unpressurized aircraft and limited frequency coverage. Thus, we are continuing the procurement of the Improved Guardrail (RC-12D), a system that corrects those limitations.

*Countering electronic emitters*

Quick Fix is an airborne offensive communications intercept, location and jamming system that will deny the enemy the use of his radios during key periods of battle. It does this by intercepting and jamming enemy communications. Quick Fix is designed to operate against air defense units and maneuver units. Quick Fix I is currently employed in a modified EH-1H aircraft. Future Quick Fix II systems will be mounted in the EH-60A BlackHawk aircraft.

*Jamming enemy communications*

Quick Look II is an airborne, computer-controlled system mounted in a Mohawk aircraft that detects, locates, and identifies enemy radars. It provides tactical field commanders with timely data on enemy missile, artillery, and antiaircraft weapons. The FY86 budget contained limited funds for product improvements to the aircraft and includes RDTE funds to support the consolidation of Guardrail and Quicklook into a single platform. Procurement funds start in FY88.

*Radar emitters*

In the area of ground-based communications jammers, our Combat Electronic Warfare Intelligence (CEWI) units will be equipped with the medium-power AN/TLQ-17A, TRAFFIC JAM, and the high-power AN/MLQ-34, TACJAM. In addition, the Army is developing a family of low-power, expendable jammers that are designed for hand emplacement or delivery by artillery projectiles. Procurement of the hand-emplaced jammers began in FY84. The Army is also equipping Combat Electronic Warfare Intelligence (CEWI) units with the PIRANHA radio electronic countermeasures set, OG-181. This device allows us to use our AN/VRC-12 series tactical radios as jammers and provides an ECM training capability to both the active and reserve forces.

# COMBAT SERVICE SUPPORT

In the initial stages of most potential conflicts, we can expect to fight outnumbered and outgunned. Therefore, the commander must have the ability to move forces rapidly about the battlefield in order to optimize their overall effectiveness and to avoid decisive engagements with forces having superior strength. The key to this capability is enhanced mobility, both air and ground, which enables us to position our forces in the right place at the right time. The Combat Service Support major mission area is an aggregation of mission areas designed to provide the commander support to the weapons systems, support systems, and their operators and crews.

*UH-1 a good, but limited performer*

The Blackhawk helicopter, the high end of the high-low utility helicopter mix, will perform air assault, air resupply and aeromedical evacuation missions, and answers the Army's need for improved battlefield mobility. Its predecessor, the UH-1, is an excellent and reliable helicopter, but is power-limited so that during hot weather and in high-altitude conditions, its payload is greatly reduced. Furthermore, in Vietnam we learned that we must reduce the vulnerability of future helicopters to small arms ground fire.

*UH-60 Blackhawk*

*Blackhawk a versatile aircraft*

The UH-60A Blackhawk is clearly superior to the UH-1. It can carry more than twice the UH-1 payload and can transport a complete, fully equipped squad faster in most weather and altitude conditions. Blackhawk also adds significantly to the mobility of the division by having the capability to reposition equipment such as the 105mm howitzer, its crew of six, and up to 30 rounds of ammunition in a single lift.

*Survivable*

The critical components in the Blackhawk are either armored or redundant to enable it to withstand multiple small arms hits. Tests have demonstrated its ability to continue flight for a minimum of 30 minutes after sustaining damage from projectiles as large as the 23mm high-explosive incendiary round. The airframe is designed to absorb impact forces by progressively deforming on impact, thereby protecting the crew in a crash. The Army's experience in Grenada with the Blackhawk proved the aircraft to be very survivable.

*Blackhawk*

The Blackhawk has been fielded in Korea, WESTCOM, Panama, Europe and FORSCOM units. Fielding to ARNG, USAR, USAREUR Medevac and FORSCOM units are in process and will be followed by a continuation of fielding to FORSCOM units.

*Stabilized production rate*

*Successful multi-year contracting*

The Blackhawk is presently being procured under a second multiyear contract (FY85-87), which has significantly stabilized the production base and produced substantial savings to the Government. FY86, the first year of the FY86-FY88 T700 series multiyear contract, included procurement of engines for the Army's UH-60 Blackhawk, AH-64 Apache, EH60 Quick Fix, Navy's SHG-60B SeaHawk and a number of other Navy programs. This highly successful program is its second multiyear contract and has resulted in significant savings to the Army. The program continues toward meeting the procurement objective of 1107 Blackhawks. The Army has accepted 700 Blackhawks as of November 1985. The Army is requesting 78 Blackhawks in FY87.

CH-47: Army's workhorse

The CH-47 Chinook is the Army's medium-lift helicopter. Designed in the 1950's and fielded in 1962, the CH-47's primary missions are movement of ammunition, repair parts, petroleum and tactical movement of artillery, troops and special weapons on the battlefield. In 1975 a modernization program was approved to upgrade the CH-47 A, B, and C models into a new D model configuration. These improvements extended the useful life of the fleet beyond the year 2000.

*CH-47D Modification Program*

Modernization includes new fiberglass rotor blades, transmission and drive system, modularized hydraulics, electrical systems, advanced flight controls, triple hook cargo system and an auxiliary power unit. These efforts greatly enhance reliability, maintainability, productivity, survivability and safety of the medium-lift fleet.

Initial operational capability was achieved on schedule in February 1984 at Fort Campbell, Kentucky. The benefits of this program to the operational units have been demonstrated by an average of 77 percent full mission capability rate (goal 70%) during the past year.

The FY 1987 budget will fund the seventh year of this effort and the third year of 48 aircraft-per-year multiyear procurement. This program continues to be a stable program with deliveries on schedule and on cost. By 31 January 1986 there will be 99 CH-47D aircraft in the field.

Truck Shortage

While other elements are essential to rapid resupply and mobility, tactical wheeled vehicles have been and will remain the backbone of our logistical system. They are vital to the fielding of new weapon systems and tactical operations Army-wide. We have a planned program to acquire tactical trucks over time to meet these needs; to fill shortages; and replace over-age, obsolete and less capable vehicles.

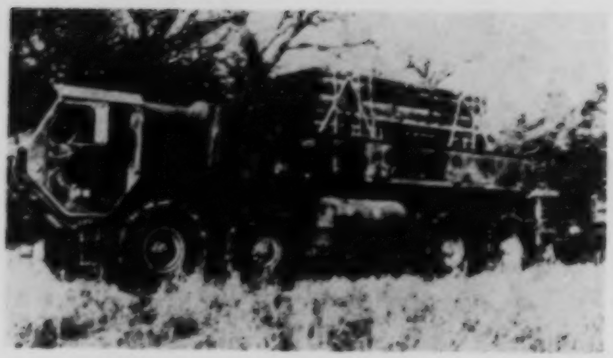
*5-Ton Truck*

*5-Ton Trucks for new systems and to replace over-age fleet*

Heading the list of workhorses is the 5-Ton Truck. It supports the introduction of such major systems as the Patriot, Pershing II, and TACFIRE, as well as meeting ammunition, general cargo transport, and other special purpose needs. In FY81, a competitively awarded 5-year multi-year contract was signed with AM General Corporation for 11,394 product improved 5-Ton Trucks, with an option to increase production by 100%. To meet critical Army requirements, as well as other Services' requirements, the options have been exercised. A competitive 5 year multiyear procurement will be awarded 3QFY86. As of December 1985, over 13,500 new 5-ton trucks have been accepted by the Army. Additionally, in 1987, we will begin prototype evaluation of a Family of Medium Tactical Vehicles to replace the 2 1/2 and 5-ton fleets that will be lighter and more air transportable, mobile, and fuel efficient. We plan to begin buying this new truck in the early 1990's.

*10-Ton Trucks for MLRS, GLCM, and Pershing II*

The Army 10-Ton Heavy Expanded Mobility Tactical Truck (HEMTT) is a vehicle that features an assemblage of commercial components. The HEMTT meets high-priority systems requirements, such as Patriot, Multiple Launch Rocket System, and tactical unit ammunition and fuel transport requirements. A competitively awarded five-year multiyear contract was signed with Oshkosh Truck Corporation in FY81. In FY87 we will continue to acquire 1523 HEMTT vehicles from the current contractor. In addition, FY 87 will be the second year of an evaluation of a follow-on Family of Heavy Tactical Vehicles which will be a follow-on to the current 10-ton HEMTT. This family will incorporate the productivity enhancements of the self-loading/unloading capabilities of a Palletized Loading System.



*10-Ton HEMTT*

*Utility Vehicles needed*

Heavy tactical wheeled vehicles are critical for the transport of heavy cargo, fuel, and ammunition, but light-load requirements dictate the need for utility trucks. Historically, this need was satisfied by the M880, commercial pickup truck series of vehicles and to some extent by the M151 1/4-ton with a 1/4-ton trailer and M561 Gama Goat, 5/4 ton. We are now beginning to fill this light-load or 5/4-ton payload requirement by two vehicle families. The first vehicle family is the Commercial Utility and Cargo Vehicle (CUCV), which serves the needs of the Army, Marine Corps, Air Force and Navy.

*Commercially available, adapt-able vehicles*

The CUCV program complies with congressional direction to commercialize at least 20 percent of the M151 1/4-ton jeep fleet. Fielding of CUCV's started in September 1983. FY85 was the last year of the 4-year multiyear procurement. Over 50,000 CUCVs have been fielded.

*HMMWV*

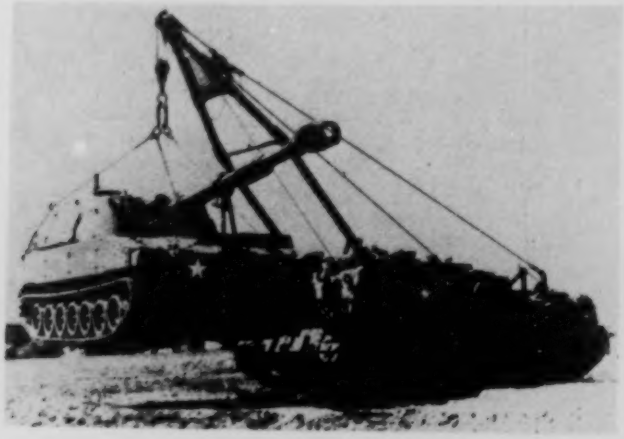
*HMMWV asset in creating lighter divisions*

The other vehicle family in the 5/4-ton-payload category, is the High Mobility Multipurpose Wheeled Vehicle (HMMWV), which is complementary to the CUCV. The HMMWV is a 5/4-ton-payload, diesel-powered, four-wheel-drive tactical vehicle that uses a common chassis with six body configurations: TOW weapons carrier, utility, ambulance, squad carrier, shelter carrier, and Stinger weapon carrier. Emphasizing the use of commercially available components, the versatile HMMWV has excellent on-and off-road capability, with a range of 300 miles. This vehicle will replace aging and obsolete vehicles in the light tactical fleet: the M561 GAMA GOAT, the M274 MULE, and M151 1/4-ton utility vehicles not replaced by the CUCV. It will perform in command and control, utility, forward observer, forward air control, and numerous other battlefield roles. This vehicle is one of our most important assets as we move toward lighter divisions. The tri-service HMMWV program also allows the Services to take advantage of the commercial production base. The FY87 budget includes money for 12,842 HMMWVs.

Our challenge for the future is to maintain the stability of our program funding to meet existing, critical truck needs. The introduction of the families of vehicles concept will meet these needs with the operational and logistic benefits of commonality. An additional and important consideration is the logistics standardization that occurs among all the Services as a result of multiyear buys of common-use tactical vehicles. It's good for industry and good for the Armed Services.

*Armored recovery vehicle supports quantitative strength*

Rounding out our combat service support transport requirement is the M88A1 recovery vehicle. The M88A1 supports the mechanized and armored combat soldier by recovering disabled tanks and other tracked combat vehicles from the battlefield.



*M-88A1 Recovery Vehicle*

Fielding of the M88A1 was initiated in 1977. A depot program to overhaul 863 gasoline-driven M88's and to convert them to diesel power was completed in FY82. Production of the M88A1 is scheduled to continue through FY88. The FY87 budget provides funding to develop and procure product improvements to the M88A1. These product improvements will upgrade the M88A1 to provide it with the capability to fully support the M60A3, M1, and M1A1 tank fleets.

Logistical support equipment gives our soldiers the vital support they need to fight successfully in sustained conflicts. In FY87, we will place greater emphasis on logistics research and development to enhance the operational capability, reduce the maintenance burden and extend mission reliability of our equipment. Logistics research and development and logistics support equipment requires continued support.

Now that we have reviewed the mission areas that put combat power on the battlefield and sustain it in battle, we shall turn to the mission area that is essential for orderly execution of all battlefield missions—command, control, and communications.

# COMMAND, CONTROL AND COMMUNICATIONS

The command and control of our forces, and the communications which make it possible, are the keys to success on the battlefield. The C3 function is analogous to the central nervous system of the body. The weapons and support systems discussed earlier are similar to muscles which react only on command and which function effectively only when they are controlled and coordinated. The systems discussed in the C3 mission area provide the means by which we control, direct, and coordinate our forces. The importance of these systems cannot be overstated.

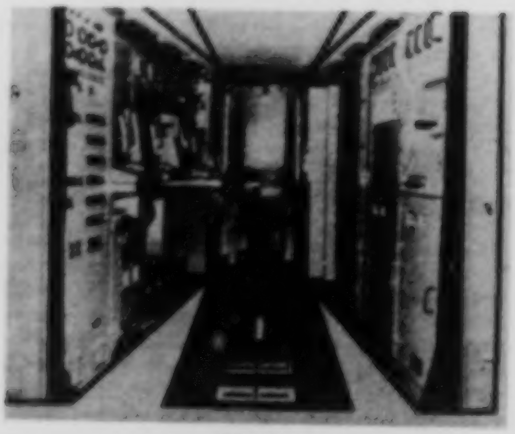
*Enormous demands and challenges*

The C3 mission area encompasses a staggering variety of demands and challenges. The demands range from a derivative of the Presidential "Hot Line," down to a simple squad radio capable of functioning under the rigors of combat. The challenges relate to an almost unbelievable number of conditions and complications. C3 systems are affected by natural and man-made interference and they are subject to enemy interruption, direction finding and jamming. Many C3 systems must be compatible with the sophistication of fixed site operations in peacetime and provide mobile capability during hostilities. In addition, C3 systems must usually be compatible and interoperable with our sister Services and NATO allies.

Communications technology is a field in which the US possesses a degree of expertise that is the envy of the world. Due to affordability constraints, however, the Army's C3 equipment has not kept pace with this technology advantage. The situation is getting better because of the increased emphasis on C3 at all levels and the many modernization initiatives being pursued. With your support we will close the technology gap during the decade of the 1980's and will move from an era of grease pencils and manual switchboards to one in which the readiness of the Army's C3 systems will be significantly improved by the systems we will now discuss.

*TRI-TAC*

The Army recently reassessed its communications architecture to insure that it was purchasing the correct mix of equipment to efficiently and effectively meet its battlefield needs. The major program included in this review was the Joint Tactical Communications (TRI-TAC) program, a Joint Service and DoD program to develop and field tactical multichannel switched communications. The broad goals of the TRI-TAC program are to achieve interoperability between Army and other DOD telecommunications systems, provide new equipment that reflects the most recent technology, eliminate duplication in development among the Services, and enhance interoperability with NATO systems.



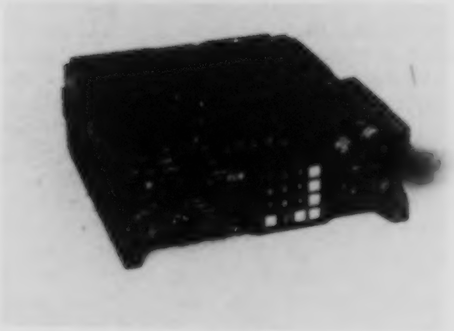
*TRI-TAC*

*Analog to digital communications*

The TRI-TAC family of equipment consists of Mobile Subscriber Equipment (MSE), automated digital telephone and message switches, secure and nonsecure telephones, multichannel radio transmission equipment, automated control facilities, tactical data and facsimile terminals, and other associated items. This equipment is urgently needed to replace the obsolete, nonsecure, manpower-intensive, manual communications equipment currently in the field.

The MSE is the most important communications system in the FY87 request; it provides corps and division commanders with the secure, flexible, mobile communications needed for command and control on the modern battlefield. This year's request procures equipment for the first operational corps and division units which will be located at Ft Hood, Texas. The MSE acquisition is an example of an innovative approach which shortens the acquisition cycle by using a nondevelopmental strategy. It is based on a willingness to take advantage of existing, proven technology and developments by our NATO allies rather than trying to develop the "ultimate" system. It enables the Army to avoid millions in development costs and start fielding a capability in 1988 rather than in the mid- 1990's.

The FY87 request provides funding for continued software development for various TRI-TAC items and the procurement of transmission equipment, unit level switches, automated control facilities, and various voice and data terminal devices together with associated communications security equipment.



*SINCGARS*

*SINCGARS reliable radio system for the soldier*

The Army does not presently have a tactical net radio system capable of operating in an electronic countermeasure environment. The Single Channel Ground and Airborne Radio System, (SINCGARS) will give the soldier a reliable, jam-resistant, secure combat net radio system capable of operating on the move and compatible with current vehicular radios and associated communications security equipment. The FY87 budget request continues the production of this urgently needed combat radio.

*PLRS*

*Knowing where we are—PLRS a combat necessity*

Any future conflict will require combat commanders to rapidly and precisely locate and identify their own forces, as well as other friendly units, on a highly mobile and extended battlefield. The Position Location Reporting System (PLRS), a joint program with the US Marine Corps, will give us that capability. It is cryptosecure, highly resistant to jamming and can be used in all weather and terrain. In the future, PLRS will be integrated with the Joint Tactical Information Distribution System (JTIDS) terminal to form the Army Data Distribution System (ADDS). It will provide the Army with a reliable, jam resistant, data communications, navigation, and identification system for use in the five primary functional areas which require C3 on the battlefield: maneuver control, fire support, air defense, electronic warfare/intelligence, and combat service support. We consider attainment of this capability a high priority for successful combat operations. Hence, the Army and Marine Corps initiated production of PLRS under a multiyear production contract in FY83 which will result in initial system fielding of PLRS for the Army in 1987.

For the Army, the PLRS production contract establishes a production base for the follow-on ADDS system. Hence, the FY87 request also provides for continued production of ADDS through modification of PLRS production equipment and initial procurement of JTIDS. This request will result in initial system fielding of ADDS in 1988.

*Maneuver Control System*

The commander must be able to aggregate volumes of information emanating from many sources in the form of reports, staff estimates, plans and orders. An automated command and control (C2) system is needed to provide a comprehensive, timely picture of the battlefield to support the decision making process. The Maneuver Control System (MCS) is such a system; it is a combination of computer hardware and C2 software that gives the tactical commander quick access to near real-time battlefield information. The MCS is the maneuver and force level control system within the Army Command and Control System (ACCS). As such it will be compatible and interoperable with the other control nodes for Air Defense, Fire Support, Intelligence and Electronic Warfare, and Combat Service Support. Critical elements of information from all the ACCS nodes will be instantly available to the force commander. Once a decision is made, MCS automates the preparation and distribution of orders to subordinate units for execution. A key feature of the program is its evolutionary implementation that began with an initial maneuver control capability in Europe in FY81. Both MCS software and hardware have evolved according to pre-planned, time-phased steps, guided by field user feedback from numerous exercises in Europe. Over the next several years, MCS evolution will continue. The hardware configuration will evolve into a mix of fully militarized equipment for use in critical locations and and severely stressed environments, and nondevelopmental items (NDI) employed in less critical locations and less severe environments. The MCS will achieve initial operating capability in 4th quarter FY86.

*Maneuver Control System*

*TACSATCOM*

Tactical Satellite Communication (TACSATCOM) systems support the ground mobile forces of the Army, Navy, Air Force, and Marine Corps by providing reliable and effective communications between widely dispersed and rapidly moving forces. Each of the systems uses a communications satellite as a relay station between terminals. Terrain is therefore less of a constraint for employment of TACSATCOM systems than for regular terrestrial systems.

*Ground station to brigade level and below*

Presently, one multichannel system and two single-channel systems are being fielded. The single-channel systems operate in the ultra high frequency range. Production of the single-channel Special Communications System, AN/MSC-64 which provides secure command and control communications from the National Command Authority to special weapons units worldwide was completed in 1983. The FY87 requests provides for completion of a super high frequency single channel receiver upgrade to improve the system survivability. Deliveries of a UHF manpack began in January 1984. The FY87 request will continue procurement of UHF manpack satellite terminals for use by Special Forces and Rangers. The Multichannel Initial System, AN/TSC-93A and AN/TSC-85A, provides tactical satellite communications down to brigade level. Production deliveries of these terminals commenced in FY85. Production of our anti-jam control modem to provide ECCM protection for this multichannel system also began in FY85.

*SCOTT meets electronic warfare threat*

To meet the severe Electronic Warfare (EW) threat and potential nuclear warfare environment of the future, a single-channel Extremely High Frequency (EHF) system will be fielded. The Single Channel Objective Tactical Terminal (SCOTT) system will provide such a jam-resistant, survivable satellite communication link. Advanced development was completed in 1983. SCOTT is the Army and other services ground terminal in the MILSTAR Satellite Communications System. During FY85, the Scott program was restructured to complete engineering development with the goal of minimizing cost, schedule and technical risks. The FY87 request continues this development.

*DSCS*

The Defense Satellite Communications System (DSCS) is a worldwide military satellite communications system which supports the Worldwide Military Command and Control System (WWMCCS), the Diplomatic Telecommunications System, and tactical/strategic C3I requirements of the Military Departments. It is the only capability in existence to satisfy strategically critical wideband command, control, and intelligence communications.

The DSCS is a joint program with the Air Force responsible for the space segment and the Army for the ground subsystem. In the past few years, the Army has initiated upgrade and modernization efforts that will result in the development, procurement, and worldwide installation of a new generation of large, medium, and small satellite terminals. These terminals will be equipped with digital communications and antijam equipment. A new automated system that will control the DSCS satellites communications payload in orbit, as well as communications that pass through the satellite, is being developed. The FY87 request supports these modernization and survivability programs.

*NAVSTAR GPS a common reference system for all services worldwide*

The NAVSTAR Global Positioning System (GPS) is a satellite-based radio position navigation system that provides users with rapid data about position, velocity, and time. When fully deployed, the system will consist of 18 satellites and thousands of user terminals.

The GPS employment includes units that normally operate at great distances from their home bases, such as cavalry, pathfinders, and Special Forces, as well as selected users to include all Army aircraft throughout the theater Army. It will also serve as an "initializer" for other position/navigation systems.

The joint GPS Program Office is staffed by Army, Navy, Air Force and NATO personnel, with the Air Force as lead. The Army is participating in the joint development of a family of manpack, vehicular, and aircraft user terminals. Testing of the first Army user terminals began in 1984.

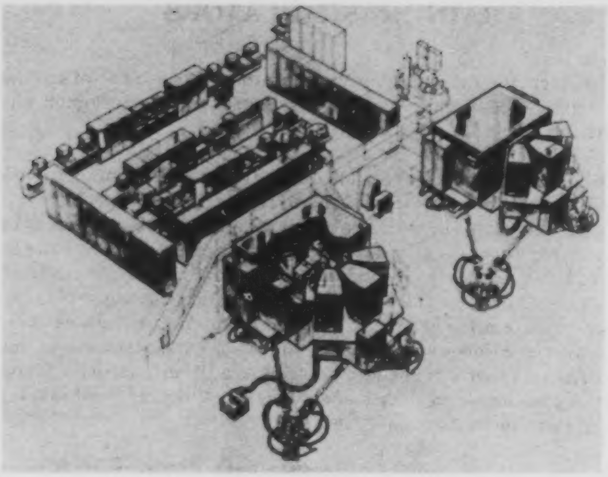
# TRAINING SIMULATORS

The FY87 request reflects the Army's commitment to the increased use of simulators. We are aware that a future Army, with all the new weapon systems we are developing, cannot train to fight on the next battlefield without them.

While training with real equipment gives soldiers and their leaders confidence that it will work in combat, training with simulators allows soldiers to repetitively practice techniques which, if performed on the actual equipment or with live ammunition, would be too hazardous, too time-consuming, or too expensive. These training devices are used in conjunction with the actual systems to provide the Army with the capability to maintain and improve the combat readiness of soldiers, crews and weapon systems, to reduce training and operating costs, to conserve scarce resources such as fuel, weapons, and ammunition, and to teach skills not attainable with operational equipment (i.e., maneuver and shoot without being killed). Training technology, much of which employs video disc, computer-generated imagery, or lasers, is a US strength which is being exploited to ensure that American soldiers and their leaders can shoot, operate and maintain their new equipment as close as possible to its capabilities.

Training devices and training simulation produce force multipliers that enhance combat effectiveness at a lower cost. The combat effectiveness of Army personnel is key to both compensating for the numerical superiority of opposing forces and for maintaining a ready force. This combat effectiveness can best be achieved by innovative, efficient, and results-oriented training. The major thrust in the development of new training devices is to develop equipment that allows a high transfer of knowledge and experience from the training situation.

The Army's past investments in research and development of training devices are now paying off as numerous devices enter or continue into production and deployment. Among these devices are the Remoted Target System, which is the target mechanism component of the Army's Range Modernization Program; the Army Training Battle Simulation System, which is a computer driven war game for combined arms operations training of battalion level commanders and staffs; the Unit Conduct of Fire Trainer, which is a gunnery trainer for Abrams Tank and Bradley Fighting Vehicle crewmembers; the Multiple Integrated Laser Engagement System (MILES), which is a family of eye-safe laser devices that are attached to weapons to realistically simulate the firing capabilities of rifles, machine guns, and other direct fire weapons. The MILES will instantly simulate the casualty-producing effects of direct fire weapons providing a capability to conduct force-on-force tactical engagement simulation field exercises with enhanced realism and feedback to teach lessons heretofore learned only in actual combat. Other simulators just as important to train soldiers are the Air Ground Engagement System, which is MILES for aircraft and air defense weapon systems, and Flight Simulators, such as the Combat Mission Simulator for the AH-64.



*Flight Simulator Complex.*

This budget reflects the Army's commitment to provide realistic tactical engagement training to the combined arms by funding efforts to simulate indirect fire and expand MILES use to more types of weapon systems. Fielding MILES for ground direct fire, aircraft, and air defense weapon systems has provided unparalleled opportunities for realistic, two-sided, tactical training worldwide. We have included money in FY87 to provide the National Guard with additional sets of MILES.

Also included in this budget are efforts to achieve long-term economies and to improve the maintenance of proficiency through the use of microprocessors and lasers to provide precision simulation in lieu of live fire. The Army has a continuing need to expand the technology base for training devices and simulation to support the development of training environments and training systems that provide the training required to win in any conflict.

## FY87 RDT&E PROGRAMS

| PROGRAM ELEMENT NUMBER | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| | TECHNOLOGY BASE | | | | |
| 61101A | IN-HOUSE LAB INDEPENDENT RESEARCH | 24.322 | 25.105 | 19.020 | 20.277 |
| 61102A | DEFENSE RESEARCH SCIENCES | 208.349 | 233.544 | 212.594 | 219.548 |
| 61103A | UNIVERSITY RESEARCH INITIATIVES | | 6.052 | 12.380 | 24.606 |
| 62105A | MATERIALS | 12.715 | 12.481 | 16.346 | 18.920 |
| 62111A | ATMOSPHERIC INVESTIGATIONS | 5.575 | 5.498 | 11.563 | 13.686 |
| 62120A | NUCLEAR WEAPONS EFFECTS/FLUIDICS | 12.476 | 22.488 | 47.797 | 54.152 |
| 62122A | SURVIVABILITY ENHANCEMENT | | | | |
| 62201A | AIRCRAFT WEAPONS TECHNOLOGY | 3.594 | 3.307 | 1.416 | 1.724 |
| 62202A | AIRCRAFT AVIONICS TECHNOLGY | 7.998 | 9.083 | 11.102 | 12.083 |
| 62209A | AERONAUTICAL TECHNOLGY | 23.713 | 27.451 | 34.814 | 43.629 |
| 62210A | AIRDROP TECHNOLGY | 1.749 | 2.053 | 2.900 | 3.094 |
| 62303A | MISSLE TECHNOLGY | 35.027 | 28.649 | 24.587 | 30.530 |
| 62307A | LASER WEAPON TECHNOLOGY | 22.007 | 11.133 | 11.228 | 14.195 |
| 62601A | TANK AND AUTOMOTIVE TECHNOLOGY | 24.547 | 22.128 | 25.711 | 29.452 |
| 62603A | LARGE CALIBER AND NUCLEAR TECHNOLOGY | 37.127 | 22.442 | | |
| 62617A | SMALL CAL AND FIRE CONTROL TECHNOLOGY | 9.691 | 11.561 | | |
| 62618A | BALLISTICS TECHNOLOGY | 49.862 | 43.413 | 46.155 | 48.288 |
| 62622A | CHEMICAL AND SMOKE MUNITIONS | 15.909 | 14.083 | 23.228 | 26.242 |
| 62623A | JOINT SERVICE SMALL ARMS PROGRAM | 6.537 | 5.493 | 11.119 | 11.163 |
| 62624A | WEAPONS AND MUNITIONS TECHNOLOGY | | | 28.663 | 27.235 |
| 62701A | TACTICAL TELEPROCESSING TECHNOLOGY | 15.020 | 17.213 | 26.894 | 29.260 |
| 62703A | COMBAT SURVEILL TARGET ACQUIS &IDENT | 6.759 | 4.516 | 7.766 | 8.021 |
| 62704A | MIL ENVIRONMENTAL CRITERIA DEV | 2.900 | 3.067 | 3.413 | 3.932 |
| 62705A | ELECTRONICS AND ELECTRONIC DEVICES | 20.056 | 21.558 | 24.039 | 26.414 |
| 62706A | CHEM BIOLOGICAL DEF/GEN INVEST | 36.852 | 39.568 | 39.656 | 44.310 |
| 62707A | MAPPING - GOEDESY | 7.994 | 9.000 | 9.678 | 10.815 |
| 62709A | NIGHT VISION INVESTIGATIONS | 18.007 | 20.840 | 28.056 | 29.890 |
| 62715A | TACTICAL ELECTRONIC WARFARE TECHNOLOGY | 10.290 | | | |
| 62716A | HUMAN FACTORS ENG SYS DEV | 10.987 | 13.993 | 17.811 | 20.127 |
| 62717A | HUMAN PERFORMANCE EFFECT/SIMULATION | 5.156 | 5.228 | 13.113 | 14.760 |
| 62719A | MOBILITY AND WEAPONS EFFECTS TECHNOLOGY | 9.217 | 12.265 | 14.879 | 15.929 |
| 62720A | ENVIRONMENTAL QUALITY HEALTH | 11.043 | 8.930 | 8.760 | 9.213 |
| 62722A | MANPOWER/PERSONNEL/TRAINING | 6.732 | 7.533 | 4.730 | 4.703 |
| 62723A | CLOTHING EQUIP AND SHELTER TECHNOLOGY | 7.932 | 8.996 | 18.012 | 17.059 |
| 62724A | JT SVC FOOD SYS TECH | 5.943 | 5.960 | 5.162 | 5.915 |
| 62725A | COMPUTER AND INFORMATION SCIENCE | 2.207 | 2.198 | 2.574 | 2.581 |
| 62727A | NON-SYSTEM TRAINING DEVICES | 5.180 | 5.042 | 4.397 | 6.874 |
| 62730A | COLD REGIONS ENGINEERING TECHNOLOGY | 7.423 | 6.990 | 4.308 | 5.025 |
| 62731A | MILITARY FACILITIES ENGINEERING TECH | 5.347 | 5.345 | 5.764 | 6.208 |
| 62733A | MOBILITY EQUIPMENT TECHNOLOGY | 13.365 | 13.708 | 15.914 | 17.848 |
| 62734A | MED DEFENSE AGAINST CHEM AGENTS | 33.265 | 31.101 | 34.613 | 39.889 |
| 62746A | TACTICAL SOFTWARE TECHNOLOGY | | 6.433 | 10.794 | 15.331 |
| 62770A | MILITARY DISEASE HAZARDS TECH | 23.949 | 27.372 | 48.677 | 51.489 |

| PROGRAM ELEMENT NUMBER | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| 62772A | COMBAT CASUALTY CARE TECH | 9.610 | 8.913 | 10.376 | 10.439 |
| 62775A | COMBAT MAXILLOFACIAL INJURY | 3.610 | 2.166 | 2.813 | 3.714 |
| 62777A | SYSTEMS HEALTH HAZARD PREVENT TECH | 22.114 | 19.428 | 22.223 | 23.130 |
| 62781A | ENERGY TECH APPL FOR MILITARY FAC TECH | 2.128 | 2.259 | 2.035 | 2.295 |
|  | TECHNOLOGY BASE TOTAL | 804.274 | 831.197 | 945.917 | 1045.085 |
|  | ADVANCED TECHNOLOGY DEVELOPMENT |  |  |  |  |
| 63102A | MATERIELS AND STRUCTURES | 8.214 | 14.289 | 20.154 | 17.772 |
| 63104A | FUELS AND LUBRICANTS | 4.479 | 3.358 | 3.527 | 4.186 |
| 63105A | ACQUIRED IMMUNE DEFICIENCY RESEARCH |  | 39.516 |  |  |
| 63201A | AIRCRAFT POWER PLANTS AND PROPULSION | 20.240 | 19.602 | 20.365 | 26.145 |
| 63206A | AIRCRAFT WEAPONS | 11.857 | 6.877 | 10.349 | 10.257 |
| 63207A | AIRCRAFT AVIONICS EQUIPMENT | 20.250 | 10.838 | 4.408 | 8.754 |
| 63209A | AIR MOBILITY SUPPORT | 7.782 |  |  |  |
| 63211A | ROTARY WING CONTROLS/ROTORS/STRUCTURES | 19.981 | 16.979 | 23.560 | 27.065 |
| 63216A | SYNTHETIC FLIGHT SIMULATOR DEVELOPMENT | 9.189 | 12.462 | 11.162 | 11.581 |
| 63218A | AIRDROP ADVANCEMENT | 3.575 | 3.819 | 4.547 | 3.628 |
| 63221A | NOE AVIATION AND NAVIGATION EQUIP | 2.900 | 3.052 | 2.370 | 5.019 |
| 63255A | OPERATIONAL ENHANCEMENTS |  |  | 2.637 | 4.370 |
| 63306A | TERMINALLY GUIDED PROJECTILES | 7.484 | 14.394 | 27.939 | 50.690 |
| 63313A | MSL/ROCKET COMPONENTS | 25.483 | 18.685 | 37.881 | 33.647 |
| 63322A | BATTLEFIELD ENVIRONMENT SIMULATION |  | 988 | 7.083 | 8.508 |
| 63324A | ARMY DEVELOPMENT AND EQUIP ACTIVITY | 38.900 | 9.588 | 11.411 | 15.393 |
| 63602A | ADVANCED LAND MOB SYSTEMS CONCEPTS | 13.152 | 16.286 | 10.890 | 19.886 |
| 63606A | LANDMINE WARFARE/BARRIER DEV | 13.222 | 11.184 | 11.344 | 13.353 |
| 63607A | JOINT SERVICE SMALL ARMS PROGRAM | 6.874 | 3.474 | 9.480 | 7.029 |
| 63621A | COMBAT VEHICLE PROPULSION SYS | 15.244 | 11.864 | 9.766 | 13.791 |
| 63631A | CMBT VEH TERRET AND CHASSIS SUBSYS | 20.921 | 16.912 | 18.895 | 22.997 |
| 63636A | COMBAT VEHICLE ARMOR/ANTI-ARMOR | 52.837 | 11.241 | 9.411 | 11.229 |
| 63637A | ADV PROPULSION/LAUNCH SYS FOR MUN | 7.902 | 8.134 | 5.887 | 9.831 |
| 63638A | NUCLEAR VULNERABILITY ADV TECHNOLOGY |  |  | 6.614 | 6.451 |
| 63640A | AMMUNITION LOGISTICS |  | 1.482 | 2.170 | 5.415 |
| 63710A | NIGHT VISION ADVANCED DEVELOPMENT | 30.511 | 31.495 | 29.080 | 36.813 |
| 63719A | SPECIAL PURPOSE DETECTORS |  |  | 2.961 | 3.939 |
| 63723A | TACTICAL C4 TECHNOLOGY INTEGRATION |  | 24.357 | 13.335 | 14.567 |
| 63725A | REMOTELY PILOTED VEHICLES/DRONES | 13.408 |  |  |  |
| 63727A | SPACE TECHNOLOGY INTEGRATION |  |  | 987 | 985 |
| 63731A | MANPOWER AND PERSONNEL | 11.349 | 13.882 | 14.204 | 16.323 |
| 63734A | ENGINEERING SYSTEMS | 1.271 | 1.927 | 5.393 | 6.450 |
| 63736A | HUMAN FACTORS ENGINEERING APPLICATIONS |  |  | 2.458 | 2.974 |
| 63737A | ANTI-RADIATION MSL COUNTER MEASURES | 4.441 | 4.890 |  |  |
| 63739A | HUMAN FACTORS IN TNG/OPER EFFECT | 9.684 | 8.974 | 9.191 | 10.377 |
| 63742A | ADV ELECTRONIC DEVICES DEV | 8.748 | 9.635 | 5.537 | 5.141 |
| 63743A | EDUCATION AND TRAINING | 10.075 | 11.787 | 7.033 | 9.028 |
| 63744A | TRAINING AND SIMULATION | 7.600 | 5.459 | 6.618 | 7.667 |
| 63748A | TEST MEASUREMENT AND DIAGNOSTIC EQUIP DEV | 4.918 | 5.159 | 7.174 | 8.902 |
| 63749A | TECHNICAL VULNERABILITY REDUCTION | 9.103 | 4.299 | 3.300 | 3.718 |
| 63752A | DEMILITARIZATION CONCEPTS | 8.312 | 9.463 |  |  |

| PROGRAM ELEMENT NUMBER | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| 63756A | DOD SOFTWARE INITIATIVES (STARS) | 12.552 | 41.492 | | |
| 63758A | ARMY BATTLEFIELD TECHNOLOGY INTEGRATION | | 11.856 | 12.385 | 12.715 |
| 63759A | CB DEF/SMK ADV TECHNOLOGY DEMONSTRATIONS | 5.177 | 3.009 | 7.484 | 3.564 |
| 63761A | ELEC WRFR VULN/SUSCEP TECH SUPPORT | 15.845 | 14.612 | | |
| 63762A | EW FEASIBILITY DEVELOPMENT | 9.652 | 7.157 | | |
| 63763A | NONSYSTEMS MEDICAL MATERIAL DEVELOPMENT | 14.644 | 16.026 | 19.492 | 23.077 |
| 63764A | MEDICAL CHEMICAL DEFENSE LIFE SUPPORT | 33.897 | 22.353 | 17.390 | 17.040 |
| 63771A | ADVANCED TACTICAL COMMUNICATIONS TECH | | | 1.461 | 1.502 |
| 63772A | ADV TACTICAL COMPUTER SCIENCE & TECH | | | 13.674 | 12.288 |
| 63773A | BATTLEFIELD SUSTAINMENT | | | 3.342 | 4.906 |
| | ADVANCED TECHNOLOGY DEVELOPMENT TOTAL | 521.673 | 502.856 | 488.034 | 570.433 |
| | STRATEGIC PROGRAMS | | | | |
| 12814A | SPECIAL PROGRAMS | | | | |
| 12821A | CLASSIFIED PROGRAMS | | | | |
| 33152A | WORLDWIDE MILITARY CMD/CNT INF SYS | 27.074 | 30.540 | 29.557 | 74.714 |
| | STRATEGIC PROGRAMS TOTAL | 220.502 | 226.877 | 278.987 | 318.447 |
| | TACTICAL PROGRAMS | | | | |
| 63209A | AIR MOBILITY SUPPORT | | 8.281 | 10.848 | 5.528 |
| 63215A | JOINT SURVIVABILITY INVESTIGATIONS | 985 | 890 | 735 | 1.045 |
| 63217A | GREATER SLOPE | 33.998 | | | |
| 63220A | ADV ROTORCRAFT TECH INTEGRATION/LHX | 51.575 | 44.311 | 44.420 | |
| 63225A | AIRDROP EQUIPMENT SYSTEMS | | 988 | 1.256 | 1.929 |
| 63302A | ANTI-TACTICAL MISSLE SYSTEM | 29.275 | 61.315 | 38.635 | 4.830 |
| 63303A | SURF-TO-SURF MSL ROCKET SYS | 24.509 | 30.253 | 42.681 | 52.185 |
| 63323A | LIGHT WEIGHT AIR DEFENSE SYSTEM | | | 21.717 | 38.016 |
| 63604A | NUCLEAR MUNITIONS AND RADIACS | 5.226 | 7.833 | | |
| 63608A | WEAPONS AND AMMUNITION | | 789 | 173 | |
| 63612A | ADV ANTI-TANK WEAPON SYSTEM (MEDIUM) | 6.003 | 60.338 | 48.735 | 141.820 |
| 63615A | LETHAL CHEMICAL MUNITIONS CONCEPTS | 14.975 | 20.141 | 25.307 | 15.660 |
| 63619A | LANDMINE/BARRIER SYSTEM | 15.683 | 22.777 | 10.477 | 8.828 |
| 63627A | SMOKE MUNITIONS AND MATERIEL CONCEPTS | 3.409 | 8.497 | 3.189 | 7.709 |
| 63628A | ARTILLERY/MORTAR AMMO DEVELOPMENT | 9.169 | 10.151 | 17.210 | 12.841 |
| 63633A | TANK/FIGHTING VEHICLE AMMO DEVELOPMENT | 10.408 | 5.665 | | |
| 63635A | MOBILE PROTECTED GUN | | | | 16.824 |
| 63639A | ARMAMENT ENHANCEMENT INITIATIVE (AEI) | | | | |
| 63641A | PROGRAM 292 | | | | |
| 63702A | ELECTRIC POWER SOURCES | 5.537 | 11.154 | 8.017 | 15.109 |
| 63705A | PHYSICAL SECURITY | 1.800 | 4.397 | 2.339 | 3.274 |
| 63706A | IDENT FRIEND OR FOE DEVELOPMENT | 13.670 | 18.479 | 20.373 | 5.678 |
| 63707A | COMMUNICATIONS DEVELOPMENT | 4.965 | 2,905 | 2.673 | 3.652 |
| 63711A | AIRCRAFT SURVIVABILITY EQUIPMENT | 3.090 | 8.128 | 4.588 | 18.170 |
| 63713A | ARMY DATA DISTRIBUTION SYSTEM | 23.949 | 37.266 | 42.122 | 22.605 |
| 63718A | ELECT WRFR VULNERABILITY/SUCEPTIBILITY | 26.465 | 22.633 | 16.912 | 22.124 |
| 63720A | CHEM/BIO DETECTION WARM/SAMP MAT CONCEPTS | 35.235 | 15.008 | | 16.019 |
| 63721A | CHEM/BIO PROTECTIVE MATERIEL CONCEPTS | 3.759 | 9.378 | 8.045 | 4.058 |

| PROGRAM ELEMENT NUMBER | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| 63723A | MISSION CRITICAL SOFTWARE | 16.601 | | | |
| 63725A | REMOTELY PILOTED VEHICLES/DRONES | | 259 | 4.917 | 19.973 |
| 63726A | COMBAT SUPPORT EQUIPMENT | 15.011 | 25.148 | 24.285 | 14.180 |
| 63730A | TACTICAL SURVEILLANCE SYSTEM | | 21.411 | | |
| 63732A | COMBAT MEDICAL MATERIAL | 6.336 | 9.271 | 8.189 | 11.396 |
| 63740A | SHORT RANGE AIR DEF COMMAND AND CONTROL | | 10.000 | 16.189 | 15.265 |
| 63741A | METEOROLOGIC EQUIPMENT DEVELOPMENT | | | | 2.192 |
| 63745A | TACTICAL ELECTRONIC SPT MEASURE SYS | 5.083 | 4.807 | | |
| 63746A | SINGLE CHAN GND & ABN RADIO SYS AD | 3.519 | 2.240 | | |
| 63747A | SOLDIER SUPPORT/SURVIVABILITY | 3.428 | 4.992 | 4.722 | 6.196 |
| 63750A | DRUG AND VACCINE DEVELOPMENT | 14.721 | 16.745 | 17.077 | 16.474 |
| 63751A | MEDICAL DEFENSE AGAINST CHEM WARFARE | 21.820 | 30.652 | 26.449 | 29.502 |
| 63754A | CLASSIFIED PROGRAM (ADV) | | | | |
| 63755A | TACTICAL ELECTRONIC COUNTERMEASURES SYS | 44.957 | 78.091 | | |
| 63757A | AIR DEFENSE ALTERNATIVES | | 30.504 | 103.944 | 188.995 |
| 63766A | TACTICAL ELECTRONIC SURVEILLANCE SYS | 9.239 | 6.735 | | |
| 63767A | COMBAT SERVICE SUPPORT CONTROL SYS | 190 | 969 | 4.608 | 5.318 |
| 63774A | NIGHT VISION SYSTEMS ADVANCED DEVELOPMENT | | | 3.307 | 10.045 |
| 64202A | AIRCRAFT WEAPONS | 6.349 | 12.527 | | |
| 64204A | AIR MOBILITY SUPPORT EQUIPMENT | 5.126 | 2.583 | 4.418 | 4.832 |
| 64206A | UH-60 BLACKHAWK | | 16.759 | | |
| 64207A | ADVANCED ATTACK HELICOPTER | 27.682 | 9.921 | 12.931 | 6.083 |
| 64216A | AIRCRAFT PROPULSION SYSTEMS | 19.975 | 69.934 | 111.301 | 149.672 |
| 64217A | SYNTHETIC FLIGHT TRAINING SYSTEMS | 17.242 | 7.673 | 10.680 | 9.843 |
| 64218A | AIRDROP EQUIPMENT DEVELOPMENT | 4.036 | 3.113 | 3.281 | 3.848 |
| 64220A | ARMY HELICOPTER IMPROVEMENT PROGRAM | 25.199 | 6.720 | | |
| 64223A | ADVANCED TECH LIGHT HELO SERIES | | | | 194.445 |
| 64268A | AIRCRAFT ENGINE COMPONENT IMPROVEMENT | 11.046 | 15.963 | | |
| 64306A | STINGER | 5.000 | 23.298 | 6.252 | |
| 64307A | PATRIOT AIR DEFENSE MISSLE SYS | 61.072 | 50.832 | | |
| 64310A | HELIBORNE MISSLE-HELLFIRE | 454 | 4.945 | | |
| 64313A | GRASS BLADE | 15.646 | 10.747 | 6.698 | 13.278 |
| 64314A | MULTIPLE LAUNCH ROCKET SYSTEM | 1.851 | | | |
| 64321A | JOINT TACTICAL FUSION PROGRAM | 76.880 | 155.209 | | |
| 64324A | JOINT TACTICAL MISSLE SYSTEM-ARMY | 76.378 | 128.426 | 88.197 | 97.719 |
| 64601A | INFANTRY SUPPORT WEAPONS | 27.202 | 29.113 | 26.044 | 5.773 |
| 64603A | NUCLEAR MUNITIONS | 11.985 | 18.074 | | |
| 64604A | MOBILITY | | 988 | 47.828 | 38.265 |
| 64608A | INFANTRY WEAPONS AND AMMUNITION | | | | 2.237 |
| 64609A | SMOKE MUNITIONS AND MATERIEL | 4.016 | 5.879 | 7.892 | 15.162 |
| 64610A | LETHAL CHEMICAL MUNITIONS | | | | 20.879 |
| 64612A | COUNTERMINES AND BARRIERS | 2.607 | 7.929 | 9.728 | 16.037 |
| 64616A | FIGHTING VEHICLE SYSTEM | 11.209 | | | |
| 64619A | LANDMINE WARFARE | 8.176 | 7.818 | 16.755 | 11.813 |
| 64630A | M1A1 DEVELOPMENT PROGRAM | 56.803 | 18.717 | 3.798 | |
| 64631A | FIELD ARTILLERY AMMUNITION | 7.967 | 27.442 | 107.275 | 84.479 |
| 64632A | 105MM TANK AMMUNITION | 146 | 1.574 | | |

| PROGRAM ELEMENT NUMBER | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| 64633A | CACTUS PLANT | | | | |
| 64701A | COMM ENGINEERING DEV | 7.801 | 10.602 | 6.473 | 6.296 |
| 64702A | JT TACTICAL INFORMATION DIST SYS | 22.764 | 12.105 | | |
| 64704A | UNATTENDED GROUND SENSORS | | 494 | | |
| 64705A | MODULAR INTEGRATED COMM AND NAV SYS | 8.282 | 4.957 | 8.224 | |
| 64706A | RADIOLOGICAL DEFENSE EQUIPMENT | 840 | 656 | | 1.587 |
| 64709A | IDENTIFICATION FRIEND OR FOE EQUIP DEV | 1.255 | | 9.871 | 18.976 |
| 64710A | NIGHT VISION DEVICES | 8.072 | 14.456 | 21.944 | 29.998 |
| 64711A | AIRCRAFT SURVIVABILITY EQUIPMENT | 14.043 | 21.662 | 19.934 | 17.743 |
| 64712A | ARMY COMMAND AND CONTROL SYS ENG | 11.858 | 9.247 | 6.113 | 11.058 |
| 64713A | COMBAT FEEDING, CLOTHING AND EQUIPMENT | 6.174 | 3.986 | 4.363 | 5.423 |
| 64714A | TACTICAL ELECTRICAL POWER SOURCES | 9.520 | 10.043 | 6.449 | 3.675 |
| 64717A | GENERAL COMBAT SUPPORT | 17.644 | 14.225 | 11.538 | 23.905 |
| 64718A | PHYSICAL SECURITY | 6.141 | 6.450 | 1.216 | 4.384 |
| 64722A | EDUCATION AND TRAINING | 6.299 | 6.531 | 4.378 | 7.273 |
| 64723A | SPECIAL PURPOSE DETECTORS | 3.315 | 3.217 | 1.181 | 961 |
| 64724A | CML/BIO DETECTION WARNING & TRAINING MAT | 1.801 | 22.845 | 31.427 | 21.038 |
| 64725A | CHEM BIO PROTECTIVE MATERIEL | 17.932 | 15.524 | 10.550 | 27.631 |
| 64727A | COMMAND AND CONTROL | 16.166 | 5.757 | 548 | 550 |
| 64730A | REMOTELY PILOTED VEHICLES | 97.783 | 73.868 | 91.880 | 19.376 |
| 64735A | INFRARED TERMINALLY GUIDED SUBMUNITION | | | 27.114 | 29.546 |
| 64740A | TACTICAL SURVEILLANCE SYSTEM | 16.494 | 17.703 | | |
| 64741A | DIVISION AIR DEFENSE COMMAND AND CONTROL | 18.399 | 32.640 | 82.065 | 116.214 |
| 64746A | AUTOMATIC TEST EQUIPMENT DEVELOPMENT | 7.923 | 17.915 | 12.325 | 13.589 |
| 64750A | TACTICAL ELECTRONIC COUNTERMEASURES SYS | 10.487 | 34.706 | | |
| 64751A | SINGLE CHAN GND & ABN RADIO SYS ED | 7.013 | 12.735 | 13.922 | 6.709 |
| 64754A | CLASSIFIED PROGRAM (ENG) | | | | |
| 64757A | MEDICAL CHEMICAL DEFENSE LIFE SPT MAT | 3.485 | 7.587 | 9.204 | 11.756 |
| 64758A | DRUG AND VACCINE DEVELOPMENT | 8.988 | 10.371 | 10.563 | 10.845 |
| 64766A | TACTICAL ELECTRONIC SURVEILLANCE SYS | 18.121 | 11.134 | | |
| 64770A | JOINT SURVEILLANCE/TARGET ATTACK RADAR | 50.000 | 43.288 | 27.882 | 6.197 |
| 64779A | JT INTEROP OF TAC CMD & CONT SYS | 37.238 | 6.337 | 7.719 | 8.485 |
| 65710A | JT CB POINT OF CONTACT, TEST & ASSESM'T | 2.345 | 2.373 | 6.249 | 6.541 |
| 23724A | HV ANTI-TANK ASSAULT WPN SYS (TOW) | 11.873 | 11.693 | 12.468 | 18.938 |
| 23726A | ADV FIELD ARTILLERY TACTICAL DATA SYS | 29.242 | 19.765 | 40.444 | 67.205 |
| 23727A | MED ANTI-TANK ASSAULT WEAPON - DRAGON | | 2.470 | | |
| 23730A | CHAPARRAL | 17.911 | 17.452 | 5.627 | |
| 23731A | SAM HAWK/HAWK IMP PROG | 21.497 | 5.149 | 10.633 | 15.902 |
| 23735A | COMBAT VEHICLE IMPROVEMENT PROGRAM | 120.110 | 72.234 | 79.203 | 67.855 |
| 23739A | AN/TSQ-73 MODIFICATIONS | | | 9.671 | 13.887 |
| 23740A | MANEUVER CONTROL SYSTEM | 21.869 | 8.565 | 9.401 | 14.901 |
| 23741A | PROD IMPR VULCAN AIR DEF SYS | 142 | | | |
| 23743A | 155MM | 27.712 | 25.474 | 35.726 | 50.164 |
| 23744A | AIRCRAFT MODIFICATIONS | 6.200 | | | |
| 23745A | EQUIPMENT UPGRADE | 5.318 | 25.036 | 23.343 | 6.462 |
| 23746A | PATRIOT PRODUCT IMPROVEMENT PROGRAM | | | 40.221 | 50.248 |
| 23747A | HELLFIRE PRODUCT IMPROVEMENT PROGRAM | | | 11.947 | 25.301 |

| PROGRAM ELEMENT NUMBER | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| 23749A | MLRS PRODUCT IMPROVEMENT PROGRAM | | | | 650 |
| 23751A | SPECIAL OPERATIONS FORCES EQUIPMENT | | | 31.242 | 59.644 |
| 23752A | AIRCRAFT ENGINE COMPONENT IMPROVEMENT | | | 14.592 | 15.977 |
| 28010A | JOINT TACTICAL COMMO PROGRAM (TRITAC) | 40.326 | 30.233 | 17.401 | 20.189 |
| 33145A | EUCOM C3 SYSTEMS | 5.501 | 1.938 | 1.078 | 1.316 |
| | TACTICAL PROGRAMS TOTAL | 1,726.341 | 2,083.622 | 2,440.170 | 2,940.527 |
| | INTELLIGENCE AND COMMUNICATIONS | | | | |
| 63712A | MAPING AND GEODESY | 3.532 | 3.186 | | |
| 64201A | AIRCRAFT AVIONICS | 1.246 | 2.212 | 2.493 | 2.482 |
| 64716A | MAPPING AND GEODESY | 3.863 | 2.227 | 11.473 | 9.122 |
| 64778A | NAVSTAR GLOBAL POS SYS (USER EQ) | 13.631 | 11.146 | 4.719 | 6.700 |
| 31307A | FOREIGN SCIENCE AND TECH CENTER | | | | |
| 31318A | HUMINT (CONTROLLED) | | | | |
| 31327A | TECHNICAL RECONNAISSANCE AND SURVEILLANCE | | | | |
| 31329A | EUCOM CSIC DESIGN | | | | |
| 31359A | SPECIAL ARMY PROGRAMS | | | | |
| 33111A | STRATEGIC ARMY COMMUNICATIONS (STARCOM) | 1.062 | | | |
| 33126A | LONG-HAUL COMMUNICATIONS (DCS) | 5.542 | 4.260 | 2.684 | 2.531 |
| 33142A | SATCOM GROUND ENVIRONMENT | 15.076 | 58.932 | 94.478 | 104.673 |
| 33401A | COMMUNICATIONS SECURITY (COMSEC) | 11.398 | 8.993 | 7.280 | 9.187 |
| | INTELLIGENCE AND COMMUNICATIONS TOTAL | 61.086 | 97.770 | 130.420 | 141.690 |
| | DEFENSEWIDE MISSION SUPPORT | | | | |
| 63315A | TARGET MISSLES | 1.496 | 3.952 | 9.731 | 12.924 |
| 63738A | NONSYSTEMS TRAINING DEVICES (NSTD) DEV | 500 | 4.842 | 3.869 | 4.826 |
| 63790A | NATO RESEARCH AND DEVELOPMENT | | 24.698 | 49.356 | |
| 64715A | NONSYSTEMS TRAINING DEVICES ENGR | 32.922 | 47.122 | 46.260 | 32.062 |
| 64726A | METEOROLOGICAL EQUIPMENT AND SYSTEMS | 12.319 | 4.967 | 1.207 | 1.367 |
| 65201A | AVIATION ENGINEERING FLIGHT ACTIVITY | 10.100 | 9.708 | 13.217 | 13.669 |
| 65301A | KWAJALEIN MISSLE RANGE | 166.265 | 152.300 | 163.470 | 175.793 |
| 65502A | SML BUSINESS INNOVATIVE RESEARCH | 16.323 | | | |
| 65702A | SUPPORT OF DEVELOPMENTAL TESTING | 48.493 | 56.404 | 50.444 | 59.969 |
| 65706A | MATERIEL SYSTEMS ANALYSIS | 15.746 | 16.043 | 16.966 | 17.932 |
| 65709A | EXPLOITATION OF FOREIGN ITEMS | 3.443 | 3.535 | 3.984 | 4.468 |
| 65712A | SUPPORT OF OPERATIONAL TESTING | 54.295 | 51.937 | 55.745 | 64.739 |
| 65716A | THREAT SIMULATORS FOR TESTING | | 32.601 | 34.279 | 33.906 |
| 65717A | NUCLEAR SURVIVABILITY TESTING & ANALYSIS | | | 3.950 | 5.553 |
| 65801A | PROGRAM WIDE ACTIVITIES | 92.133 | 171.766 | 85.484 | 93.979 |
| 65802A | INTL COOPERATIVE RESEARCH AND DEV | 511 | 936 | 977 | 1.284 |
| 65803A | TECHNICAL INFO ACTIVITIES | 5.750 | 6.196 | 6.772 | 7.875 |
| 65804A | AMC MAJOR RANGES AND TEST FACILITIES | 324.825 | 357.120 | 207.799 | 230.412 |
| 65805A | MUN STANDARDIZAT'N EFFECTIVENESS & SAFTEY | 7.145 | 11.367 | 11.610 | 11.609 |

| PROGRAM ELEMENT NUMBER | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| 65806A | DOD HIGH ENERGY LASER SYSTEMS TEST FAC | 32.811 | 19.940 | 20.729 | 21.471 |
| 65810A | RDTE SUPPORT FOR NON-DEVELOPMENTAL ITEMS | | | 9.194 | 13.170 |
| 65872A | PRODUCTIVITY INVESTMENTS | 11.855 | 20.747 | 53.893 | 15.548 |
| 65894A | REAL PROPERTY MAINTENANCE (RDT&E) | | | 174.536 | 214.054 |
| 65896A | BASE OPERATIONS (RDT&E) | | | 202.951 | 211.115 |
| 65898A | MGT HQ (RESEARCH/DEVELOPMENT) | 41.921 | 12.018 | 11.264 | 11.582 |
| 78011A | INDUSTRIAL PREPAREDNESS | 92.356 | 90.951 | 29.105 | 30.145 |
| | DEFENSEWIDE MISSION SUPPORT TOTAL | 971.309 | 1,099.150 | 1,266.772 | 1,289.452 |
| TOTAL RESEARCH DEVELOPMENT TEST & EVAL, ARMY | | 4,305.185 | 4,841.472 | 5,550.300 | 6,305.636 |

FY87 AIRCRAFT PROCUREMENT, ARMY

| SSN | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| | FIXED WING | | | | |
| A02700 | C-12 CARGO AIRPLANE | 24.0 | 12.0 | | |
| A02000 | GUARDRAIL/COMMON SENSOR ROLL | | | | 3.3 |
| A02005 | RC-12D RECON AIRPLANE | 89.3 | | | 72.1 |
| | FIXED WING TOTAL | 113.3 | 12.0 | 0.0 | 75.4 |
| | ROTARY | | | | |
| A03400 | CH-47 CARGO HELICOPTER (CHINOOK) | 110.0 | | | |
| A04300 | EH-60A HELICOPTER (QUICKFIX) | 97.6 | 104.6 | 135.0 | |
| A04300 | EH-60A HELICOPTER (QUICKFIX) ADV PROC | 30.4 | 24.4 | 16.9 | |
| A06605 | AH-64 ATTACK HELICOPTER (APACHE) | 1159.2 | 1087.8 | 1189.3 | |
| A06605 | AH-64 ATTACK HELICOPTER (APACHE) ADV PROC | 87.6 | 55.3 | 39.1 | |
| A05002 | UH-60A BLACK HAWK (MYP) | 271.0 | 210.9 | 155.4 | 336.6 |
| A05002 | UH-60A BLACK HAWK (MYP) ADV PROC | 171.8 | 199.0 | 195.0 | 191.4 |
| | ROTARY TOTAL | 1927.6 | 1682.0 | 1730.7 | 1419.1 |
| | MODIFICATIONS | | | | |
| AZ3530 | OV-1 MOHAWK SURVEILLANCE AIRPLANE | 24.9 | 22.7 | 24.9 | 39.3 |
| AZ2000 | RC12-D RECON AIRPLANE | 6.2 | | | |
| AZ2100 | RV-1 RECON AIRPLANE | 4.7 | | 2.7 | 5.4 |
| AA0150 | AHIS ATTACK HELICOPTER (COBRA-TOW) | 70.3 | 128.9 | 61.0 | 81.0 |
| AA6605 | AH-64 MODS | | | 33.4 | 33.0 |
| AA0250 | CH-47 CARGO HELICOPTER (MYP) | 231.5 | 219.0 | 208.4 | 173.9 |
| AA0250 | CH-47 CARGO HELICOPTER (MYP) ADV PROC | 159.9 | 124.8 | 58.6 | 69.2 |
| AA0300 | CH-54 CARGO HELICOPTER (TARHE) | | .5 | 1.3 | 10.3 |
| AZ1200 | EH-1 ELECTRONIC HELICOPTER (Q-FIX MOD) | 3.7 | | | |
| AA0400 | OH-58 OBSERVATION HELICOPTER (KIOWA) | 48.8 | | | |
| AA0600 | UH-1 UTILITY HELICOPTER (IROQUOIS) | 6.5 | 11.7 | 6.3 | 18.8 |
| AA0490 | UH-60 BLACKHAWK MODS | 15.8 | 13.6 | 7.7 | 18.8 |
| AZ2200 | ARMY HELO IMPROVEMENT PROGRAM (AHIP) | 161.0 | 166.6 | 164.9 | 113.2 |
| AZ2200 | ARMY HELO IMPROVEMENT PROGRAM ADV PROC | 47.2 | 20.9 | 45.4 | 129.1 |
| AZ3900 | AIR TO AIR STINGER ACFT MOD | | | 28.8 | 41.5 |
| AA0700 | AIRBORNE AVIONICS | 9.5 | 1.0 | .1 | 1.9 |
| AA0720 | ASE MODIFICATIONS CLOSE COMBAT | | | 3.5 | .1 |
| AA0725 | MODIFICATIONS UNDER $2.0M (AIRCRAFT) | 1.1 | .1 | .1 | 2.6 |
| AZ3405 | ACFT WW | 66.9 | 16.3 | 12.0 | 24.4 |
| Z3407 | SOF AIRCRAFT MODIFICATIONS | | | 3.5 | 67.0 |
| | MODIFICATIONS TOTAL | 857.9 | 726.1 | 662.6 | 829.5 |
| | SPARES AND REPAIR PARTS | | | | |
| AA0950 | SPARE PARTS | 677.7 | 814.3 | 710.5 | 786.9 |
| | SPARE PARTS TOTAL | 677.7 | 814.3 | 710.5 | 786.9 |
| | GROUND SUPPORT AVIONICS | | | | |
| AZ3504 | AIRCRAFT SURVIVABILITY EQUIPMENT | | | 11.6 | 88.5 |
| | GROUND SUPPORT AVIONICS TOTAL | 0.0 | 0.0 | 11.6 | 88.5 |

## FY87 AIRCRAFT PROCUREMENT, ARMY

| SSN | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| | OTHER SUPPORT | | | | |
| AZ3000 | AVIONICS SUPPORT EQUIPMENT | 53.7 | 65.0 | 57.9 | 80.4 |
| BA9999 | HELIBORNE C2 CONSOLE | | | | 2.3 |
| AZ3020 | MLS AVIONICS | | | | 7.6 |
| AZ3100 | COMMON GROUND EQUIPMENT | 15.6 | 33.5 | 28.4 | 29.7 |
| AA0050 | AIR TRAFFIC CONTROL | 8.9 | 9.0 | 4.8 | 2.9 |
| AZ3800 | SYNTHETIC FLIGHT TRAINING SYSTEMS | 156.3 | 117.1 | 37.7 | 61.5 |
| AZ3300 | INDUSTRIAL FACILITIES | 39.2 | 59.3 | 16.0 | 22.8 |
| A50100 | WAR CONSUMABLES | 3.6 | 5.9 | 4.5 | 4.2 |
| | OTHER SUPPORT TOTAL | 277.4 | 289.8 | 149.3 | 211.4 |
| | ARMY AIRCRAFT APPROPRIATION TOTAL | 3853.8 | 3524.2 | 3264.7 | 3410.8 |

## FY87 MISSLE PROCUREMENT, ARMY

| SSN | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| | SURFACE-TO-AIR MISSLE SYSTEM | | | | |
| C22100 | CHAPARRAL | 31.0 | 54.9 | 103.7 | 114.5 |
| CC2100 | NON LINE OF SIGHT AIR DEFENSE SYSTEM | | | | 14.2 |
| CC2200 | AIR DEFENSE SYS HEAVY | | | 9.1 | 65.4 |
| CC2300 | AIR DEFENSE DIV SYSTEM LIGHT | | | | |
| CA0275 | OTHER MISSLE SUPPORT | 8.3 | 5.0 | 6.5 | 4.7 |
| C49100 | PATRIOT (MYP) | 958.8 | 928.1 | 951.5 | 912.7 |
| C49100 | PATRIOT (MYP) ADV PROC | | | 45.3 | 40.1 |
| C18500 | STINGER (MYP) | 207.3 | 246.6 | 251.7 | 337.7 |
| C18500 | STINGER (MYP) ADV PROC | | | 40.3 | 45.5 |
| | SURFACE-TO-AIR SYSTEM TOTAL | 1205.4 | 1234.6 | 1408.1 | 1609.5 |
| | AIR-TO-AIR MISSLE SYSTEM | | | | |
| C70000 | LASER HELLFIRE SYSTEM | 224.0 | 223.2 | | 190.6 |
| | AIR-TO-SURFACE MISSLE SYSTEM TOTAL | 224.0 | 223.2 | 0.0 | 190.6 |
| | ANTI-TANK/ASSAULT MISSILE SYSTEM | | | | |
| C59300 | TOW 2 | 184.0 | 160.9 | 134.6 | 176.3 |
| C59300 | TOW 2 ADV PROC | 16.2 | 22.0 | 15.5 | |
| C76500 | PERSHING | 370.0 | 224.5 | 31.8 | |
| C67600 | MULTIPLE LAUNCH ROCKET SYSTEM (MYP) | 371.6 | 468.9 | 474.2 | 480.2 |
| C67600 | MULTIPLE LAUNCH ROCKET SYSTEM ADV PROC | 137.4 | 41.0 | | |
| | ANTI-TANK/ASSAULT MISSLE SYSTEM TOTAL | 1079.2 | 917.3 | 656.1 | 663.5 |
| | MODIFICATIONS | | | | |
| C50700 | PATRIOT | 11.8 | 16.5 | 38.6 | 52.8 |
| C24200 | CHAPARRAL | 93.8 | 106.7 | 5.2 | 13.5 |
| C35200 | HAWK | 55.6 | 46.9 | 68.2 | 50.5 |
| C61700 | TOW | 31.0 | 16.9 | 53.0 | 38.9 |
| C57300 | DRAGON | | | 4.7 | |
| C76200 | LANCE MODIFICATIONS | | | 3.8 | 16.1 |
| C97500 | LCSS | 3.8 | | | |
| C92800 | PERSHING MODIFICATIONS | 3.0 | | | 10.1 |
| C54000 | AN/TSQ-73 | 11.4 | | | |
| | MODIFICATIONS TOTAL | 210.4 | 187.0 | 173.5 | 181.9 |
| | SPARES AND REPAIR PARTS | | | | |
| CA0250 | SPARES AND REPAIR PARTS | 244.8 | 286.8 | 150.9 | 301.3 |
| | SPARES AND REPAIR PARTS TOTAL | 244.8 | 286.8 | 150.9 | 301.3 |
| | SUPPORT EQUIPMENT AND FACILITIES | | | | |
| C93000 | AIR DEFENSE TARGETS | 30.4 | 19.8 | 32.4 | 31.6 |
| CL2000 | ITEMS LESS THAN $2.0M (MISSILES) | 6.6 | 3.7 | 1.5 | 2.2 |
| CA0100 | PRODUCTION BASE SUPPORT | 56.5 | 29.9 | 15.7 | 17.7 |
| CA4600 | OTHER PRODUCTION CHARGES | 38.6 | 2.0 | | |
| | SUPPORT EQUIPMENT AND FACILITIES TOTAL | 132.1 | 55.4 | 49.6 | 51.5 |
| | ARMY MISSLE PROCUREMENT APPROPRIATION TOTAL | 3095.9 | 2904.3 | 2438.2 | 2998.3 |

## PROCUREMENT WEAPONS AND TRACKED COMBAT VEHICLES, ARMY

| SSN | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| | **TRACKED COMBAT VEHICLES** | | | | |
| G80300 | CARRIER, COMMAND POST LIGHT, FT, M577A2 | 33.4 | 30.6 | 64.1 | |
| G80711 | CARRIER, PERSONNEL, FT, ARM, M113A3 | 8.9 | 117.7 | | 80.8 |
| G80702 | BRADLEY FIGHTING VEHICLES (MYP) | 844.8 | 905.9 | 1121.8 | 1163.6 |
| G80702 | BRADLEY FIGHTING VEHICLES (MYP) ADV PROC | 24.9 | 27.6 | 20.6 | 13.2 |
| G20900 | BRADLEY (BFVS) TRAINING DEVICES | 56.5 | 73.2 | 9.5 | |
| GZ2500 | BRADLEY (BFVS) TRAINING DEVICES (MOD) | | | | 6.2 |
| G80100 | FIELD ARTILLERY AMMUNITION SUPPORT VEH | 81.2 | 64.8 | 67.5 | 77.4 |
| G24600 | HOWITZER, MED SP, FT, 155MM, M109A2 | 51.8 | | | |
| G82500 | RECOVERY VEHICLE, MED, FT, M88A1 | 148.3 | 199.4 | 42.8 | 121.1 |
| G82916 | ABRAMS TANK SERIES ROLL (MYP) | 1524.7 | 1505.0 | 1643.6 | 1738.8 |
| G82916 | ABRAMS TANK SERIES ROLL (MYP) ADV PROC | 308.3 | 348.2 | 351.4 | 356.0 |
| GC2600 | M60 SERIES TANK TRAINING DEVICES | 13.9 | 16.8 | 33.5 | 32.4 |
| GB1300 | M1 SERIES TANK TRAINING DEVICES | 37.3 | 61.0 | 9.5 | .9 |
| | TRACKED COMBAT VEHICLES TOTAL | 3134.0 | 3350.2 | 3364.3 | 3590.4 |
| | **MODIFICATION OF TRACKED COMBAT VEHICLES** | | | | |
| GB1930 | CARRIER, MOD | 44.7 | 54.7 | 48.4 | 61.5 |
| GZ2000 | IMPROVED TOW VEHICLE (ITV) (MOD) | 32.6 | | | |
| GZ2300 | FIST VEHICLE (MOD) | 72.8 | 71.9 | 53.8 | 18.2 |
| GZ2400 | BFVS SERIES (MOD) | 3.9 | 12.0 | 35.1 | 56.7 |
| GA0400 | HOWITZER, MED SP FT 155MM M109 (MOD) | 28.8 | 6.0 | 20.8 | 64.5 |
| GZ3000 | ARMORED VEH LAUNCH BRIDGE (AVLB) (MOD) | 13.4 | 15.6 | | |
| GA0650 | TANK, COMBAT, FT, 105MM GUN, M60SER (MOD) | 212.2 | 105.2 | 48.3 | 77.6 |
| GA0700 | TANK, M1 SERIES (MOD) | 9.2 | 53.9 | 80.4 | 175.7 |
| GZ3405 | 9WW | | | | 2.8 |
| GA9002 | MOBILE TRAINING BASE EQUIP | | | 17.0 | 17.6 |
| GA9003 | HOST NATION SUPPORT | | | 4.7 | |
| | MOD OF TRACKED COMBAT VEHICLES TOTAL | 417.6 | 319.3 | 308.5 | 474.6 |
| | **SUPPORT EQUIPMENT AND FACILITIES** | | | | |
| GA0150 | SPARES AND REPAIR PARTS (TCV-WTCV) | 426.1 | 600.6 | 469.8 | 542.1 |
| GA0175 | VALUE ENGINEERING | 1.0 | | | |
| GL3100 | ITEMS LESS THAN $2.0M (TCV-WTCV) | 1.7 | .8 | 2.0 | 2.0 |
| GA0050 | PRODUCTION BASE SUPPORT (TCV-WTCV) | 75.3 | 78.9 | 57.8 | 41.8 |
| | SUPPORT EQUIPMENT AND FACILITIES TOTAL | 504.1 | 680.3 | 529.6 | 585.9 |
| | **WEAPONS AND OTHER COMBAT VEHICLES** | | | | |
| GZ6000 | FOLLOW-ON AIR DEFENSE GUN | | 150.0 | | |
| G01300 | HOWITZER, LIGHT, TOWED, 105MM, L119 | | | 26.5 | 32.0 |
| G01402 | HOWITZER, MED, TOWED, 155MM, M198 | | | | 11.9 |
| G11101 | MACHINE GUN, 7.62MM, M60 | | | 5.0 | 5.4 |
| G13000 | ARMOR MACHINE GUN, 7.62MM M240 | 23.4 | | 24.2 | 25.0 |
| G10100 | MOUNT MACH GUN CAL 50 M3 | | | | 2.2 |
| G12901 | SQUAD AUTOMATIC WEAPON (SAW) 5.56MM | | | 12.9 | 16.5 |
| G13400 | GRENADE LAUNCHER, AUTO, 40MM, MK 19-3 | 5.4 | | | |
| G71100 | LAUNCHER, SMOKE GRENADE | 4.8 | 2.1 | 1.8 | 2.0 |

## PROCUREMENT WEAPONS AND TRACKED COMBAT VEHICLES, ARMY

| SSN | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| G02202 | MORTAR, 81MM, M252 | 11.3 | 5.7 | 10.1 | 10.5 |
| G03000 | MORTAR, 120MM | | 5.0 | 13.2 | 22.4 |
| G14900 | M16 RIFLE | 36.6 | 35.0 | 36.8 | 38.8 |
| G15300 | PERSONAL DEFENSE WEAPON, 9MM | 9.1 | 7.5 | 4.4 | 5.1 |
| G21100 | VEH RAPID FIRE WPN SYS-BUSHMASTER (MYP) | 39.1 | 31.9 | 37.3 | 38.0 |
| G21100 | VEH RAPID FIRE-BUSHMASTER ADV PROC | 3.0 | 8.3 | 3.2 | 2.2 |
| G21400 | TANK MUZZLE BORESIGHT DEVICE | 3.2 | 4.0 | | |
| | WEAPONS AND OTHER COMBAT VEHICLES TOTAL | 135.9 | 249.5 | 175.4 | 212.0 |
| | MODIFICATION OF WEAPONS AND OTHER COMBAT VEHICLES | | | | |
| GZ2800 | M16A1 RIFLE MODS | | 3.3 | 3.3 | 3.5 |
| GC0925 | MODIFICATIONS UNDER $2.0M (WOCV-WTCV) | .9 | 2.5 | 4.0 | 4.8 |
| | MODIFICATIONS OF WEAPONS/OTHER VEHICLES | .9 | 5.8 | 7.3 | 8.3 |
| | SUPPORT EQUIPMENT AND FACILITIES | | | | |
| GC0150 | SPARES AND REPAIR PARTS (WOCV-WTCV) | 22.0 | 28.6 | 17.6 | 28.0 |
| GL3200 | ITEMS LESS THAN $2.0M (WOCV-WTCV) | 4.3 | 2.9 | 3.3 | 3.4 |
| GC0050 | PRODUCTION BASE SUPORT (WOCV-WTCV) | 52.2 | 40.2 | 37.0 | 43.5 |
| GC2701 | CANNON TUBE FORGINGS FOR SURGE | | | 9.6 | |
| | SUPPORT EQUIPMENT AND FACILITIES TOTAL | 78.5 | 71.7 | 67.5 | 74.9 |
| | ARMY WEAPONS AND TRACKED COMBAT VEH TOTAL | 4271.1 | 4676.8 | 4452.6 | 4946.1 |

AMMUNITION PROCUREMENT, ARMY

| SSN | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| E25100 | CTG, 4.2-IN HE M329A2 W/O FUZE | 18.4 | 32.4 | 22.0 | |
| E25501 | CTG, 120MM: HE, XM933, W/FUZE M734 MO | | | 44.7 | 42.6 |
| E25503 | CTG, 120MM: ILLUM, XM930 | | | 5.5 | 5.6 |
| E25504 | CTG, 120MM: SMOKE, XM929 | | | 14.3 | 14.2 |
| E23900 | CTG, 105MM, HEAT MP T M456A2 | 45.0 | 41.6 | 7.7 | |
| E24000 | CTG, 105MM,TP-T, M490 | 39.3 | 32.1 | | 17.3 |
| E67902 | CTG, 105MM, TRACE-P FOR M833 | 5.7 | 2.3 | | |
| E22100 | CTG, 105MM, DS-TP M724 | 80.8 | 89.4 | 41.6 | 42.2 |
| E67901 | CTG, 105MM, APFSDS-T M833 | 46.4 | 42.3 | 20.3 | 36.9 |
| E73100 | CTG, 120MM APFSDS-T M829 | 41.7 | 132.0 | 75.9 | 89.6 |
| E73200 | CTG, 120MM HEAT-MP-T, M830(MYP) | 33.2 | 42.1 | 27.8 | 17.9 |
| E73300 | CTG, 120MM TP-TM831 (MYP) | 40.4 | 39.6 | 38.8 | |
| E73400 | CTG, 120MM TPCSDS-T, M865(MYP) | 62.6 | 65.0 | 104.9 | 123.2 |
| E28100 | PROJ, 155MM, HE, ICM M483 | 246.9 | 269.8 | 173.0 | 91.3 |
| E67800 | PROJ, 155MM, SMK, WP, M825 | 12.5 | 13.1 | 13.5 | 10.9 |
| E67100 | PROJ, 155MM, HE ADAM M692 | 32.0 | | | |
| E67200 | PROJ, 155MM, HE, ADAM M731 | 34.9 | 20.6 | 33.9 | 28.0 |
| E67500 | PROJ, 155MM, HE, RAAMS M718 | | | 11.9 | 8.9 |
| E67502 | PROJ, 155MM, HE RAAMS M741 | 100.9 | 75.1 | 105.4 | 37.1 |
| E68500 | PROJ, 155MM, BASEBLEED, XM864 | | | 31.6 | 71.7 |
| E67600 | PROJ, 155MM, HE COPPERHEAD (EA) | 200.8 | 219.1 | 8.2 | 190.1 |
| E28001 | PROJ, 155MM, CHEM GB-2 | | 21.7 | 60.6 | |
| E27201 | CHARGE, PROPELLING, M155MM GREEN BAG M3 | 32.4 | 12.2 | 38.0 | 6.1 |
| E27301 | CHARGE, PROPELLING, M155MM, WHITE BAG, M4 | 30.0 | | | |
| E27303 | CHARGE, PROPELLING, M155MM, RED BAG M203 | | 20.4 | 20.0 | 37.6 |
| E27100 | CHARGE, PROPELLING, M155MM, RED BAG M119 | 120.4 | | 55.6 | 46.9 |
| E6700 | PROJ, 8-INCH, HE ICM (DP), M509 | 129.5 | 50.0 | | |
| E66600 | PROJ, 8-INCH, HE, RAP, M650 | 15.4 | 26.0 | 37.3 | 33.4 |
| E29202 | CHARGE, PROPELLING, 8-INCH WB, M188 | 64.7 | | 4.0 | |
| E62704 | FUZE, PROXIMITY, M732 | | | | 16.7 |
| E62208 | FUZE, PD M739/M739A1 | 3.6 | | | |
| E61302 | FUZE, MTSQ M577/M577A1 | 50.8 | 49.3 | 11.7 | 21.4 |
| E61503 | FUZE, MTSQ M582/M582A1 | 4.8 | 10.5 | 11.2 | 1.6 |
| E63000 | PRIMER, PERC, M82 | | 2.9 | 1.8 | 1.4 |
| E40601 | GROUND IMP MINE SCAT SYS AP M74 (MYP) | 19.5 | | | |
| E40602 | GROUND IMP MINE SCAT SYS AT M75 (MYP) | 39.2 | | | |
| E72194 | CANISTER MINE (VOLCANO) PRACTICE XM88 | | | 1.9 | 3.0 |
| E72195 | CANISTER MINE (VOLCANO) XM87 | | | 31.6 | 31.2 |
| E76900 | MTR RKT 5 IN MK22 MOD4 | 4.0 | 11.4 | 13.3 | 9.3 |
| E75100 | LINE CHARGE M58A3 (MCLIC) | 12.5 | 22.3 | 24.4 | 17.9 |
| E71200 | MODULAR MINE PACK SYSTEM | 15.1 | | 23.4 | 36.2 |
| E77100 | PURSUIT DETERRENT MUNITION | | | 2.1 | |
| E55400 | DEMOLITION MUNITIONS & OTHER | 18.4 | 16.5 | 13.7 | 17.1 |
| E50700 | DEMO KIT BANGALORE TORPEDO | | 3.0 | | |
| E53400 | RETROFIT, CTG 105MM HE M760 | 2.3 | | | |
| E36100 | LIGHTWEIGHT MULTI-PURPOSE WEAPON | 43.0 | 58.2 | 82.5 | 84.9 |
| E32900 | LIGHT WGT MULTI PURPOSE SYSTEM TRNR | 3.4 | 3.1 | 2.5 | 2.4 |
| E37327 | HYDRA 70 RKT, MPSM HE M261 WHD (MYP) | 33.0 | 28.9 | | |

## AMMUNITION PROCUREMENT, ARMY

| SSN | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| E37309 | HYDRA 70 RKT, HE/RS (M151/M433) | | | | 12.9 |
| E37314 | HYDRA 70 RKT, ILLUM M257 WHD | | | | 6.2 |
| E37334 | HYDRA 70 RKT, MPSM PRAC M267 WHD | 5.4 | 5.4 | 2.7 | 16.6 |
| E37335 | HYDRA 70 RKT, HE/PD (M151/M423/MK66) | | 7.0 | 44.8 | |
| E34000 | GRENADE, HAND, ALL TYPES | 17.7 | 28.7 | 27.4 | 24.0 |
| E33300 | GREN SMK SCREENING RP L8A1/L8A3 | | 9.8 | 6.3 | 3.8 |
| E32500 | GRENADE, SMOKE SCREENING IR M76 | 8.2 | 11.5 | 9.0 | 4.4 |
| E46900 | SIGNALS, ALL TYPES | 25.7 | 14.9 | 18.0 | 14.4 |
| E51200 | SIMULATORS, ALL TYPES | 12.2 | 19.9 | 4.3 | 20.5 |
| | CONVENTIONAL AMMUNITION TOTAL | 2079.6 | 1927.6 | 1789.0 | 1927.0 |
| | MISCELLANEOUS | | | | |
| EB0016 | AMMO COMPONENTS/SUPPORT, ALL TYPES | 32.0 | 21.3 | 20.3 | 15.1 |
| E77000 | CAD/PAD | | .5 | 2.5 | 2.3 |
| EA0055 | ITEMS LESS THAN $2.0M (MISC-AMMO) | 10.7 | 11.0 | 5.2 | 8.3 |
| EA0650 | SPARES AND REPAIR PARTS | 1.0 | | 1.2 | 1.7 |
| EA0575 | AMMUNITION PECULIAR EQUIPMENT | .9 | 5.2 | 7.8 | 8.1 |
| E64500 | NITROGUANIDINE (LB) | 27.7 | 25.0 | 23.2 | 24.8 |
| EA0525 | COMP A-5 | | | 12.2 | 12.5 |
| EA0512 | COMP C-4 | | | 9.5 | 9.8 |
| EA0514 | PBX 0280 | | | 3.8 | 3.9 |
| EA0520 | COMP LX-14 | | | 3.8 | 4.0 |
| EA0523 | HMX EXPL-805 | | | 5.7 | 5.9 |
| EA0535 | WAR RESERVE STOCKPILING (EXPL/PROPELLANT) | 33.0 | | | |
| EA8000 | AMMO 9WW/ELT | 1.7 | 1.7 | 1.6 | 2.9 |
| | MISCELLANEOUS TOTAL | 107.0 | 64.7 | 96.8 | 99.3 |
| | PRODUCTION BASE SUPPORT | | | | |
| EP1000 | PROVISION OF INDUSTRIAL FACILITIES | 282.5 | 280.6 | 159.0 | 300.5 |
| EA0054 | COMPONENTS FOR PROVE-OUT | | 14.0 | 8.7 | 16.4 |
| EP2000 | LAYAWAY OF INDUSTRIAL FACILITIES | 19.5 | 20.5 | 22.9 | 19.7 |
| EP4000 | JEFFERSON PROVING GROUND MODERNIZATION | | 2.0 | 2.2 | |
| EP4100 | CHEMICAL DEMILITARIZATION PROGRAM | | 81.3 | | |
| EP1220 | MODERNIZATION PROJECTS | | 103.1 | 161.1 | |
| | PRODUCTION BASE SUPPORT TOTAL | 302.0 | 501.5 | 353.9 | 336.6 |
| | ARMY AMMUNITION PROCUREMENT APPROPRIATION TOTAL | 2500.3 | 2497.2 | 2254.0 | 2424.0 |

## OTHER PROCUREMENT , ARMY

| SSN | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| D00200 | CHASSIS TRAILER GEN 2 1/2 TON 2W M200A1 | 5.6 | 7.6 | 4.1 | |
| D00800 | CHASSIS, TRAILER, GP, 3 1/2, 2W, M353 | | | 3.7 | |
| D01100 | DOLLY SET, TRANS SHELTER, 2 1/2T, M720 | | | | 3.3 |
| D01300 | DOLLY SET, TRANS SHELTER, 5 1/4T, M832 | | | | 3.0 |
| D00501 | DOLLY SET, TRANS SHELTER, 7 1/2T, M1022 | 3.6 | 5.5 | 6.2 | 7.8 |
| D15201 | MOTORCYCLE, GED, 2W, ROUGH TERRAIN | | 2.0 | 7.1 | 7.8 |
| D01500 | SEMITRAILER BB/CONT 22 1/2T M871 C/S | 3.5 | | | 15.9 |
| D01600 | SEMITRAILER BB/CONT 34T M872 C/S | | 3.4 | 6.4 | 7.6 |
| D01000 | SEMITRAILER, LB, 12T M270A1-M269A1 | | 9.3 | | |
| D00700 | SEMITRAILER, LOW BED, 40T M870 (C/S) | 3.2 | 12.2 | 1.9 | 15.2 |
| D02400 | SEMITRAILER, LOW BED HET, XM1000 | | | | 32.8 |
| D02300 | SEMITRAILER, TANK, 5000G | | 19.8 | 8.8 | 8.5 |
| D02700 | SEMITRAILER, TANK, 7500G, BULKHAUL | | | 7.3 | 10.3 |
| D03200 | SEMITRAILER, VAN ELECTRONIC 6T 2W M373A2 | | | | 2.0 |
| D04800 | SEMITRAILER,VAN SUPPLY 12T, 2W, M129A2C | | | 7.0 | |
| D06200 | TRAILER, CARGO 3/4T, 2W, M101A2 W/E | | 3.5 | 5.6 | 12.7 |
| D06400 | TRAILER, CARGO, 1 1/2T, 2W, M105A2 | 11.5 | 11.1 | | 18.2 |
| D05700 | TRAILER, HEAVY, EXPANDED MOBILITY | 4.7 | | 7.4 | 8.3 |
| D06800 | TRAILER TANK WATER 400G 1 1/2T, 2W M149A1 | | 4.0 | 5.9 | 18.4 |
| D15400 | HI MOB MULTI-PURP WHLD VEH (HMMWV) (MYP) | 311.1 | 313.3 | 330.6 | 128.5 |
| D11300 | COMMERCIAL UTILITY AND CARGO VEHICLE | 315.4 | | | |
| D19000 | SMALL UNIT SUPPORT VEHICLE (SUSV) | | 13.8 | 26.2 | 32.2 |
| D14000 | TRUCK, 5T, 6X6, ABT (MYP) | 347.2 | 216.8 | | 400.0 |
| D16200 | TRUCK, 10T, 8X8, ABT (MYP) | 199.6 | 116.1 | 234.3 | 70.4 |
| D15900 | TRUCK, TRACTOR, LINE HAUL, M915A1 | | | | 58.1 |
| D16000 | TRUCK, YARD TYPE, M878 (C/S) | | 3.1 | | |
| DA0925 | MODIFICATION OF IN SERVICE EQUIPMENT | .8 | 1.5 | 3.8 | 15.5 |
| G38900 | SHOP EQUIPMENT, AUTO MAINT & REPAIR | | .9 | 2.5 | 2.5 |
| DL5110 | ITEMS LESS THAN $2.0M (TAC VEH) | 3.1 | 1.7 | 1.9 | 1.4 |
| | TACTICAL VEHICLES TOTAL | 1209.3 | 745.6 | 670.7 | 880.4 |

### NON-TACTICAL VEHICLES

| SSN | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| D23000 | PASSENGER CARRYING VEHICLES | 28.8 | 30.0 | 13.8 | 10.8 |
| D24850 | GENERAL PURPOSE VEHICLES | 33.8 | 39.9 | 34.9 | 39.3 |
| D25000 | SPECIAL PURPOSE VEHICLES | 10.5 | 13.0 | 9.7 | 14.0 |
| | NON-TACTICAL VEHICLES TOTAL | 73.1 | 82.9 | 58.4 | 64.1 |

### SUPPORT EQUIPMENT AND FACILITIES

| SSN | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| DA0350 | SPARES AND REPAIR PARTS (TAC) | 121.5 | 135.0 | 136.6 | 126.5 |
| DA0400 | PRODUCTION BASE SUPPORT (TAC) | 3.2 | | | 1.8 |
| | SUPPORT EQUIPMENT AND FACILITIES TOTAL | 124.7 | 135.0 | 136.6 | 128.3 |

### TELECOMM EQUIP - READINESS COMMAND COMM

| SSN | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| BB5777 | JCSE EQUIPMENT (USREDCOM) | 4.7 | .3 | 1.8 | 3.7 |
| BZ9950 | CINCS INITIATIVE | | | 4.1 | 4.7 |
| BB2000 | CLASSIFIED PROJECT 9WW | 24.4 | 14.2 | 9.1 | 8.2 |
| | TELECOMM EQUIP - READINESS COMMAND TOTAL | 29.1 | 14.5 | 15.0 | 16.6 |

## OTHER PROCUREMENT , ARMY

| SSN | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| | TELECOMM EQUIP - JOINT TACTICAL COMM PROG | | | | |
| BA1055 | MOD RCRD TFC TERM (MRTT) | 18.3 | 29.3 | 31.9 | 41.3 |
| BA1050 | DIG GROUP MULTIPLEXER (DGM) | 20.1 | 20.4 | 10.8 | 19.5 |
| BA1045 | RPTR/TERM ASSMBLGS | 29.3 | 15.7 | 19.9 | 29.1 |
| BA1040 | RADIO TERMINALS AN/TRC-170 | 44.7 | 29.2 | 32.4 | 38.8 |
| BA1035 | MAINTENANCE SYSTEM AN/ARM-164 | | | 3.3 | |
| BA1030 | UNIT LEVEL SWITCHES | | 10.5 | 12.2 | 42.9 |
| B69100 | CON SYS CON EL AN/TYQ-16 | | 15.9 | 23.6 | 33.6 |
| B50400 | DIG NSEC VTER TA-954 | 3.6 | 4.0 | 3.9 | 6.5 |
| B72300 | ANDVT TAC TERM, CV 3591 | | 4.0 | 3.9 | 5.3 |
| B74402 | LIGHTWEIGHT DIGITAL FACSIMILE | 8.3 | | 1.2 | 6.2 |
| BB1610 | MOB SUBSCRIBER EQUIP | 63.3 | 335.3 | 903.7 | 1019.8 |
| BB1600 | MOD OF IN-SVC EQ (TRI-TAC) | 39.6 | 22.5 | 9.9 | 14.4 |
| | TELECOMM EQUIP-JOINT TAC COMM TOTAL | 227.1 | 486.8 | 1056.7 | 1257.4 |
| | TELECOMM EQUIP - COMBAT SUPPORT COMM | | | | |
| BA0027 | COMM SYS (HTLD) | | 8.5 | | |
| B00500 | SINCGARS | 121.0 | 102.1 | 204.0 | 309.0 |
| K08200 | DIGITAL DATA GENERATOR BOX SG-1139 | 4.1 | | | |
| B13300 | HAND CRANK GENERATOR, G-76 | | | 2.5 | |
| BU0055 | IHF RADIO MODS | | | | 14.6 |
| BU8100 | IMP HF RADIO FAMILY | 29.7 | 26.6 | 11.1 | 11.6 |
| Z15700 | OPTICAL LONG HAUL,TRAN SYS | | | 9.3 | 11.0 |
| B10500 | PWR SUPPLY PP-6148/U | | .9 | 4.0 | 2.7 |
| B45200 | PULSE FORM RESTORER TD-206 | 1.1 | | | |
| B05300 | RADIO SET AN/PRC-70 | | 11.6 | | |
| BC2200 | SOF MOD RADIOS | | | 4.5 | 3.2 |
| B45500 | ANTENNA GROUP OE-254 | | 2.5 | 6.5 | 5.2 |
| B02600 | SMALL UNIT TRANS AN/PRC-68 | | 1.0 | | |
| W18300 | SMALL UNIT TRANSCEIVER | | | 3.7 | 7.0 |
| B01300 | STEER NULL ANT PROC, CP-1380 | | 15.4 | | |
| B76000 | TELETYPEWRITER TERMINAL AN/UGC-74 | 5.2 | 2.1 | | |
| B71100 | VEHICULAR INTERCOM SYSTEM | | | 10.2 | 13.3 |
| BB1550 | MOD OF IN SVC EQUIP (CSC) | 28.0 | 18.9 | 26.4 | 20.6 |
| BZ8250 | RDF COMM (SW ASIA) | 24.5 | 19.5 | 14.9 | 21.3 |
| BL5220 | ITEMS LESS THAN $2.0M (CSC-C-E) | 6.6 | 7.1 | 5.9 | 4.6 |
| BC2150 | SPEC OPS COMM SUP ELMT | | 11.3 | 15.2 | 1.8 |
| | TELECOMM COMBAT SPT EQUIP TOTAL | 220.1 | 227.5 | 318.2 | 425.9 |
| | TELECOMM EQUIP-NMCS WIDE SUPPORT COMM | | | | |
| BA8110 | SECURE CONFERENCING PROJECT | | | 4.5 | 4.4 |
| | TELECOMM EQUIP-NMCS WIDE SPT COMM TOTAL | —— | —— | 4.5 | 4.4 |
| | TELECOM EQUIP-STARCOM NON-DCS | | | | |
| BU3770 | AR TELECOM AUTO PR (ATCAP) | 6.7 | 9.2 | 3.2 | 5.6 |
| BU4160 | C-E FACILITIES/PROJECTS | 21.7 | 18.8 | 4.7 | 10.5 |
| BU4000 | SOUTHCOM C3 UPGRADE | | 13.8 | 16.0 | 15.4 |
| BD3100 | ELECTROMAG COMP PROG (EMCP) | .2 | .6 | .5 | .6 |
| | TELECOMM EQUIP-STARCOM NON-DCS TOTAL | 28.6 | 42.4 | 24.4 | 32.1 |

## OTHER PROCUREMENT , ARMY

| SSN | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
|  | TELECOMM EQUIP-LONG HAUL COMM (DCS) |  |  |  |  |
| BU0200 | AUTODIN (DCS) | 7.4 | 4.8 |  |  |
| BU0300 | DEFENSE DATA NETWORK (DDN) | 6.5 | 6.5 |  |  |
| BB4960 | SECURE VOICE IMPRV PROG (SVIP) | .8 |  |  |  |
| BU3800 | TRANSMISSION MEDIA (EUCOM) | 11.9 | 16.2 | 11.1 | 12.9 |
| BU3850 | TRANSMISSION MEDIA (PACOM) | 15.4 | 30.8 | 15.8 | 6.3 |
| BU3610 | WW TECH COM IMP PR (WWTCIP) | 9.9 | 5.3 | 2.7 | 4.0 |
|  | TELECOMM EQUIP-LONG HAUL COMM TOTAL | 51.9 | 63.6 | 29.6 | 23.2 |
|  | TELECOMM EQUIP-SATCOM-GND ENVIRON |  |  |  |  |
| BB8501 | DIGITAL EQUIPMENT (DSCS) | 24.8 | 39.9 | 29.3 | 29.0 |
| BB8504 | INTERCONNECT FACILITY (DSCS) | 8.7 | 7.9 | 2.2 | 4.9 |
| BA8300 | JAM RESISTANT SECURE COM (JRSC) | 27.9 | 19.6 | 9.3 | 17.2 |
| BB8507 | MED SAT TERM AN/GSC | 58.9 | 62.0 |  |  |
| BZ3500 | SPRD SPEC MUL ACC(DSCS) | 27.1 | 18.0 |  |  |
| BB8509 | DSCS OPERATIONS CONTROL SYS (DOCS) | 41.6 | 31.2 | 80.3 | 66.2 |
| BB8416 | MOD IN-SVC EQUIP (DSCS) | 3.6 | 8.5 |  |  |
| K28900 | MPK SAT UHF TERM, AN/PSC-3 | 1.9 | 3.9 | 5.0 | 5.0 |
| K45900 | VEH SAT UHF TERM, AN/VSC-7 |  | 1.4 | 1.4 | 1.4 |
| K23700 | SINGLE CHANNEL OBJECT TACT TERM (SCOTT) |  |  |  | 32.7 |
| BB8417 | MOD IN-SVC EQUIP (TAC SAT) | 42.8 | 53.3 | 7.0 | 4.5 |
|  | SATCOM-GND ENVIRONMENT TOTAL | 237.3 | 245.7 | 134.5 | 160.9 |
|  | TELECOMM EQUIP-EUCOM C3 SYSTEM |  |  |  |  |
| BB8422 | EUCOM C3 (NWS) | 48.0 | 98.6 | 68.4 | 16.7 |
| BB8430 | PACOM C3 (NWS) |  |  | 13.0 | 15.0 |
| BA8200 | EUCOM ALTERNATE SPT HQ (ASH) | 6.9 | 7.7 | 3.8 |  |
| BA8250 | USAREUR C2 PROJECT |  |  | 7.7 | 7.8 |
|  | TELECOMM EQUIP-EUCOM C3 SYSTEM TOTAL | 54.9 | 106.3 | 92.9 | 39.5 |
|  | TELECOMM EQUIP-COMSEC EQUIPMENT |  |  |  |  |
| T68000 | AUTO KEY DC KGX-93/TSEC |  | 4.3 | 4.1 | 4.2 |
| BZ8950 | SECURE VOICE IMPROVEMENT PROGRAM (COMSEC) | 17.5 | 12.0 | 13.7 | 19.1 |
| T53000 | LOOP KEY GEN TSEC/KG-82 | 9.2 | 2.1 |  |  |
| T54000 | DED LOOP ENCRYP DEV KG-84 | 14.4 | 31.8 | 18.7 | 19.9 |
| T67500 | TNK ENCRYP TSEC/KG-93 |  | 2.2 | 2.1 | 2.7 |
| T02100 | TSEC/KG-94 | 11.7 | 7.8 | 12.3 | 9.9 |
| T05400 | TSEC/KG-95 KEY GENERATOR | 7.1 |  |  |  |
| T55000 | INT LEV T SET TSEC/ST-34 | 1.5 | .8 |  |  |
| T54500 | DIG SUB VOICE TSEC/KY-68 | 3.6 | 2.0 |  |  |
| T88500 | TSEC/KY-90 | 2.8 | 5.4 |  |  |
| T06200 | KEY GENERATOR, TSEC/KG-87 |  | 2.0 | 1.8 | 1.3 |
| T84500 | KGV-6/TSEC | 1.1 |  |  |  |
| T06400 | COMSEC MODULE, TSEC/KGV-13 |  | 3.8 | 19.9 | 6.7 |
| T99500 | FREQ MODULE, KGV-10/TSEC | 12.9 | 13.9 | 9.1 | 13.8 |
| T5000 | SPEECH SECURE EQ TSEC/KY-57 | 39.8 | 35.0 |  |  |
| T50500 | SPEECH SECURE EQ TSEC/KY-58 | 5.1 |  |  |  |
| T90500 | TSEC/KYV-5 (VACTOR) SECURE EQUIP |  | .9 | .5 | 1.5 |
| BQ0200 | TEMPEST (COMSEC) | 5.2 | 1.1 | .7 | 1.2 |

OTHER PROCUREMENT , ARMY

| SSN | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| T06300 | KOK-13/TSEC (KDC) | | | 1.9 | .8 |
| T01600 | TSEC/KGV-8 (THORNTON) SECURE MODULE | | | .6 | 3.1 |
| T88000 | BERDAN KGV-9 | 4.4 | | | |
| T03200 | TSEC/KGV-11/SECURE MODULE | | 1.3 | 1.4 | 1.5 |
| T87000 | UMSTEAD CC (CI-11-1) | 2.8 | 3.0 | | |
| T87500 | UMSTEAD RT (CI-11-2) | 2.1 | 6.8 | | |
| T92500 | BATSON II, TSEC/CI-14 | | 8.4 | | |
| BL5264 | ITEMS LESS THAN $2.0M (COMSEC) | 7.6 | 8.2 | 11.7 | 7.7 |
| | TELECOMM EQUIP-COMSEC EQUIPMENT TOTAL | 148.9 | 152.8 | 98.5 | 93.4 |
| | TELECOMM EQUIP-BASE COMM | | | | |
| BB8700 | BASE COMM (CONUS) | 35.8 | 34.5 | 35.8 | 36.9 |
| BU4165 | LOCAL AREA NETWORK (LAN) | | | 1.7 | 10.6 |
| BB8800 | BASE COMM (EUCOM) | 19.3 | 6.8 | 7.9 | 13.1 |
| BB8900 | BASE COMM (PACOM) | 4.9 | 4.0 | 1.6 | 6.0 |
| BU1130 | DA COMD + CON SYS (DACCS) | 3.6 | 10.3 | | |
| BU1200 | ARMY OPNS CTR | | 5.0 | 4.3 | |
| BQ0100 | PENTAGON TELECOM CTR (PTC) | 1.9 | 9.8 | 4.1 | |
| | TELECOMM EQUIP-BASE COMM TOTAL | 65.5 | 70.4 | 55.4 | 66.6 |
| | TELECOMM EQUIP-TMDE | | | | |
| BZ5270 | TMDE MODERNIZATION | 21.5 | 27.0 | 16.9 | 19.4 |
| | TELECOMM EQUIP-TMDE TOTAL | 21.5 | 27.0 | 16.9 | 19.4 |
| | OTHER ELECT SYS/EQUIP-INTELLIGENCE SUPPORT | | | | |
| BB2050 | 4TH PSYOP GROUP | | | 12.5 | 11.1 |
| K28800 | ALL SOURCE ANALYSIS SYSTEM (ASAS)-TIARA | | | | |
| V29600 | COMMANDERS TACTICAL TERMINAL | | | 14.7 | |
| V07300 | TRAILBLAZER | 58.6 | 19.2 | | |
| BZ7315 | TAC ELEC SURV SYS | 19.3 | 15.8 | 4.0 | 3.5 |
| K06800 | MANPACK RADIO DF SYSTEM (MRDFS) | | 7.0 | 5.6 | |
| V07800 | TEAM PACK | | 6.0 | | |
| BZ9750 | MOD IN SVCEQU (INT SPT) TIARA | 48.7 | 20.2 | 37.3 | 35.9 |
| BL5278 | ITEMS LESS THAN $2.0M (INT-SPT-C-E) | 3.7 | 5.6 | .5 | .1 |
| BB6010 | FT DEVENS TRAINING SUPPORT | 13.5 | .4 | .4 | .5 |
| BA0326 | TROJAN | 2.9 | 9.2 | | |
| | OTHER ELECT SYS/EQUIP-INTEL SPT TOTAL | 146.7 | 83.4 | 262.2 | 216.7 |
| | OTHER ELECT SYS/EQUIP-GEN DEF INTEL PROG | | | | |
| BD3900 | INTELL DATA HANDLING SYS (IDHS) | 14.2 | | 23.0 | |
| BZ8920 | TECH RECON AND SURV SYS (TECRAS) | 5.5 | | 10.9 | |
| BL5282 | ITEMS LESS THAN $2.0M (FCI/S&IA-C-E) | | | 1.1 | |
| BL5283 | ITEMS LESS THAN $2.0M (GDIP-C-E) | 5.0 | — | 9.1 | — |
| | OTHER ELECT SYS/EQUIP-INTEL SPT TOTAL | 24.7 | | 44.1 | |
| | OTHER ELECT SYS/EQUIP-AUTO DATA PROCESS SYS | | | | |
| BD3970 | VERT INSTL AUTO BASELINE (VIABLE-BASOPS) | 33.7 | 18.7 | 41.8 | 36.7 |
| BA2090 | VIABLE INSTALLATIONS IN EUROPE & WESTCOM | 8.7 | | | |
| B78400 | BATTERY COMPUTER SYSTEM | 28.7 | 17.7 | 11.0 | |

OTHER PROCUREMENT , ARMY

| SSN | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| BD3950 | AMC FIVE YEAR ADP PROGRAM | 4.9 |  | 4.0 | 5.0 |
| B28600 | ADV FIELD ARTILLERY TACT DATA SYS |  | 25.6 |  | 10.7 |
| BU1400 | ARMY DATA DISTRIBUTION SYSTEM-ADDS |  | 21.6 | 75.5 | 162.3 |
| BZ9200 | TRADOC AUTOMATION | 9.9 |  | 3.7 | 1.9 |
| BZ9300 | USAREUR TACTICAL AUTOMATION |  | 2.2 | 2.0 | 2.1 |
| BD3955 | LIFE CYCLE SOFTWARE SUP (LCSS) | 1.0 | 3.5 | 9.1 | 6.5 |
| BE4150 | ADPE FOR NON TAC MGT INFO SYS | 59.8 | 42.1 | 40.4 | 38.7 |
| BE4152 | SUPERCOMPUTERS |  |  | 22.9 | 24.3 |
| BE4154 | ARMY CORPORATE DATABASE |  |  | .9 | 2.4 |
| BE4156 | SOLDIER DATA TAG |  |  |  | 5.2 |
| BE4158 | PROJECT 80X PHASE II |  |  | 12.9 | 17.4 |
| BE4157 | TRANS OF PERS PROP |  |  | 2.9 | 1.2 |
| BE4160 | STD ARMY AUTO CONTRACT SY |  |  | 6.8 | 6.8 |
| B78301 | DIGITAL MESSAGE DEVICE | 12.0 |  |  |  |
| B83900 | FIRE SUPPORT TEAM DIGITAL MESSAGE | 14.5 | 17.2 | 17.0 | 5.6 |
| BZ9851 | FORWARD ENTRY DEVICE |  |  | 12.0 | 17.9 |
| BE4200 | NON-CENTRALLY MANAGED ITEMS |  | 105.3 |  |  |
| BA9300 | MANEUVER CONTROL SYSTEM | 27.9 | 59.9 | 56.9 | 57.4 |
| BC1000 | MOD IN SVC COMD/CONTROL (C2) |  | 2.9 |  |  |
| BZ9350 | CORPS/THEATER ADP SVC CTR (CTASC) | 6.0 |  | 9.7 | 20.4 |
| B62000 | TACT ARMY CMBT COMPT SY (TACCS) | 20.7 | 44.6 | 42.9 | 16.8 |
| B40200 | DECENTIZED AUTO SER SUP SYS MOD 'B' | 38.2 |  |  |  |
| K99200 | COMPUTER BALLISTICS: MORTAR XM-23 | 12.7 | 6.0 |  |  |
| BZ8889 | CSS LOG APPLC AUTO MARK/READ SYMBS (LOG MARS) |  | 10.6 | 11.4 | 12.3 |
| BE4100 | WWMCCS INFORMATION SYSTEM (WIS) | 14.2 | 7.1 | 36.2 | 29.0 |
| BZ8888 | UNIT LEVEL COMPUTER (ULC) | 2.2 | 5.5 |  |  |
|  | OTHER ELECT SYS/EQUIP-ADP SYS | 295.2 | 390.5 | 420.0 | 480.6 |
|  | OTHER ELECT SYS/EQUIP-AUDIO VISUAL |  |  |  |  |
| BZ8480 | AFRTS (AUDIO VISUAL) | 4.1 | 7.8 | 8.0 | 6.7 |
| BE1000 | DIG STRG & RTRVL ENGRG DATA SYS (DSREDS) | 4.8 | 24.3 |  |  |
| BL5298 | ITEMS LESS THAN $2.0M (A/V-C-E) | 12.7 | 11.3 | 9.1 | 17.6 |
|  | OTHER ELECT SYS/EQUIP-AUDIO VISUAL TOTAL | 21.6 | 43.4 | 17.1 | 24.3 |
|  | OTHER ELECT SYS/EQUIP- ELECTRONIC WARFARE |  |  |  |  |
| V02300 | COUNTERMEASURES SER AN/TLQ-17A |  | 5.7 |  | 5.8 |
| V31100 | JAMMER, HAND EMPLACED, EXPENDABLE |  |  |  |  |
| V07200 | TACJAM, AN/MLQ-34 | 32.0 | 19.0 | 33.0 |  |
| VV0255 | TACTICAL DECEPTION (TAC-D) |  | 5.2 |  |  |
| BA6100 | MOD IN SVC EQUIP (EW) | 12.6 | 2.1 | 8.3 | 19.3 |
| BL5292 | ITEMS LESS THAN $2.0M (EW-C-E) |  | 2.9 | .8 | .8 |
|  | OTHER ELECT SYS/EQUIP-ELECT WARFARE TOTAL | 44.6 | 34.9 | 42.1 | 66.3 |
|  | OTHER ELECT SYS/EQUIP-TACTICAL ELECTRONICS |  |  |  |  |
| B81100 | BATTERY CHARGER PP-7286/U | 1.7 | 3.5 | 3.0 | 8.2 |
| K02900 | POWER SUPPLY, PP-6224 | 1.0 | 1.9 | 3.2 | 3.2 |
| B92400 | COMPUTER/INDICATOR, CP-696/PD |  | 4.0 | 3.7 | 4.8 |
| K27800 | METEROLOGICAL DATA SYS (FAMAS) | 33.6 | 33.0 | 32.8 | 33.7 |
| B92000 | GND/VEH LASER LOC DESIGNAT'R (G/VLLD) | 45.0 | 45.0 |  |  |

OTHER PROCUREMENT , ARMY

| SSN | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| B81200 | HAND HELD LASER RANGEFINDER AN/GVS-5 | 4.9 | | 6.8 | 10.5 |
| BZ7900 | INTRUSION DETECTION DEVICES | 26.8 | 16.6 | 20.8 | 7.0 |
| K47800 | NAVSTAR GLOBAL POSITIONING SYSTEM | | 9.7 | 5.2 | 9.9 |
| M75700 | POSITION/AZIMUTH DETERMINING SYS (PADS) | | 19.9 | 35.7 | 37.3 |
| K37500 | TAM-6 NIGHT SIGHT MAINTENANCE FACILITY | 2.3 | 4.2 | | |
| K56900 | AN/TAM-3 TEST SET, NIGHT VISION SIGHT | 1.1 | 2.3 | | |
| K35500 | NIGHT OBS DEVICE LONG RANGE AN/TAS-6 | | | | 29.7 |
| KA3500 | NIGHT VISION GOGGLES | 34.8 | 66.9 | 63.2 | 70.0 |
| K41500 | NIGHT VISION SIGHT INDIV WPN N/PVS-4 | 12.6 | 9.9 | 10.0 | 14.6 |
| B26200 | POS LOCATION REPORTING SYS (PLRS) (MYP) | 50.3 | 45.1 | 4.0 | |
| B43300 | RADIAC SET AN/VDR-2 | | 2.0 | 4.0 | 6.3 |
| BA9200 | REMBASS-TIARA | 21.1 | 22.0 | | |
| A02900 | RPV TA/DESIGN AERIAL RECON SYS (TADARS) | | 21.9 | 117.7 | 193.3 |
| BA1080 | JOINT STARS (ARMY) | | | 63.4 | 107.9 |
| K71400 | SHOP SHELTER MTD ASM-189 | | | 2.2 | 10.8 |
| K71500 | SHOP SHELTER MTD (STOR) AN/ASM-190 | | | | 3.3 |
| K71700 | TEST SET, RADAR, AN/TPM-25 | 1.2 | | | 4.9 |
| K10600 | SHOP SHELTER MDT-REP AN/ASM-146 | | | 2.1 | |
| BZ7325 | MODIFICATION OF IN SVC EQUIP (TAC EL) | | 3.5 | 38.5 | 41.5 |
| BL5295 | ITEMS LESS THAN $2.0M (TACT ELEC-C-E) | 7.9 | 9.5 | 8.4 | 9.6 |
| | OTHER ELECT SYS/EQUIP-TACT ELECT TOTAL | 244.3 | 318.9 | 424.7 | 606.5 |
| | OTHER ELECT SYS/EQUIP-TMDE FOR TACTICAL ELECTRONICS | | | | |
| K07900 | TEST STA, ELECTRONIC EQUIP, AN/USM-410 | 5.2 | 8.9 | | |
| K18400 | BASE SHOP TEST FACILITY | | | | 21.1 |
| K51600 | CONTACT TEST SET | | | | 7.3 |
| M87001 | TMDE FOR STE/ICE | | 5.6 | 6.5 | 7.7 |
| M87003 | CORE ELECTRONIC AUTO TEST (STE-X) | | 8.5 | 3.0 | 6.5 |
| | ELECT SYS/EQUIP-TMDE FOR TAC ELECT TOTAL | 5.2 | 23.0 | 9.5 | 42.6 |
| | OTHER ELECT SYS/EQUIP-SUP EQUIP AND FAC | | | | |
| BA9500 | SP/REP PARTS (TELECOMM-C-E) | 190.6 | 189.2 | 183.2 | 202.6 |
| BA9700 | SP/REP PART (COMSEC) | 7.5 | 14.6 | 11.4 | 13.0 |
| BA9600 | SPARES AND REPAIR PARTS | 155.4 | 205.0 | 260.3 | 308.9 |
| BA9800 | WAR RESERVE SPARES | 8.0 | 18.0 | | |
| BF5500 | SPECIAL PROGRAMS | 50.7 | 95.0 | 115.8 | 208.5 |
| BB9050 | QUICK RETURN ON INVESTMENT (QRIP) PGM | 1.1 | .5 | | |
| BB9000 | PRODUCTIVITY INVESTMENT FUNDING | 27.1 | 40.7 | 31.1 | .4 |
| BB9051 | PROD ENHANCING CAP INVESTMENT PROG (PECIP) | | 1.0 | 21.8 | |
| BF5400 | PRODUCTION BASE SUPPORT (C-E) | 12.5 | 5.0 | 8.1 | 3.1 |
| | SUPPORT EQUIP AND FACILTIES TOTAL | 452.9 | 569.0 | 631.7 | 736.5 |
| | CHEMICAL DEFENSIVE EQUIPMENT | | | | |
| M96200 | SIM DET CHEM AGENT AUTO ALARM XM81 | 1.2 | 4.7 | | |
| M67400 | DECONTAMINATE APP PWR DR LT WT XM17 | 3.3 | 6.4 | 3.9 | 7.0 |
| MA5000 | MASK, PROTECTIVE, NBC | 34.7 | 30.3 | 19.9 | 61.7 |
| S02200 | CHEMICAL AGENT MONITOR | 7.8 | 19.4 | | 19.6 |
| M97400 | SIMP COLL PROT EQUIP XM20 | | 3.9 | 4.1 | 5.8 |
| M98300 | MODULAR/COLL PROT EQUIP FOR VV AND S | 9.3 | 3.1 | | 10.7 |

OTHER PROCUREMENT , ARMY

| SSN | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| M98800 | AUTO CHEMICAL AGENT ALARM (ACADA), XM22 | | | 9.0 | 7.1 |
| M99104 | GEN SET, SMOKE, MECH: PUL JET, XM157 | | 4.2 | 7.0 | |
| MA7000 | MODS IN SVC (CHEM) | 6.0 | | | |
| | CHEMICAL DEFENSIVE EQUIPMENT TOTAL | 62.3 | 72.0 | 43.9 | 111.9 |
| | BRIDGING EQUIPMENT | | | | |
| M23600 | RIBBON BRIDGE ERECTION BOAT | | 25.4 | 19.2 | 18.9 |
| M26600 | BRIDGE, FLOAT RIBBON, INTERIOR BAY | | 7.1 | 7.2 | 7.5 |
| M26700 | BRIDGE, FLOAT RIBBON RAMP | | 3.8 | 3.2 | 3.5 |
| M26800 | BRIDGE, FLOAT RIBBON, TRANSPORTER | 12.4 | 18.0 | 18.2 | 18.5 |
| ML5315 | ITEMS LESS THAN $2.0M (BRIDGING) | 1.7 | .9 | 1.3 | 1.8 |
| | BRIDGING EQUIPMENT TOTAL | 14.1 | 55.2 | 49.1 | 50.2 |
| | ENGINEER (NON CONSTRUCTION) EQUIPMENT | | | | |
| G27000 | GEMSS AUX MINE DISPENSER XM138 | | 2.0 | 3.9 | 4.0 |
| G39100 | DISPENSER MINE XM139 | | | 1.7 | 1.5 |
| G22500 | MIXER/PUMPER UNIT (MPU) TEXS | | | | 13.0 |
| X00700 | MARKING SYS, CLEAR LANE | | 3.0 | 3.2 | 2.0 |
| M15300 | E DET SET, MINE, MET/NON-MET, AN/PRS-8 | | 8.1 | | 5.6 |
| M17900 | DETECTING SET, MINE, AN/PSS-12 | | | 4.9 | 3.1 |
| R06100 | MINE PLOW | | | 5.5 | 4.7 |
| X00600 | MINE CLEARING ROLLER | 2.6 | 3.5 | 3.7 | 7.6 |
| G00501 | REMOTE CONTROL UNIT (MOPMS) | | 4.6 | 9.8 | 9.6 |
| R20000 | SURVEY SET DISTANCE MEASURING INFRARED | 1.1 | | 2.8 | |
| M05900 | M-9 ARMORED COMBAT EARTHMOVER (ACE) (MYP) | 11.7 | 42.4 | 30.4 | 159.1 |
| ML5320 | ITEMS LESS THAN $2.0M (ENG NON-CONST) | 1.8 | 3.3 | .9 | .9 |
| | ENGINEER (NON CONSTRUCTION) EQUIP TOTAL | 17.2 | 66.9 | 66.8 | 211.1 |
| | COMBAT SERVICE SUPPORT EQUIPMENT | | | | |
| MF9300 | AIR CONDITIONERS VARIOUS SIZE/CAPACITIES | 16.2 | 14.8 | 32.2 | 14.7 |
| M86600 | FIELD KITCHEN, MOBILE, TRL MTD | | 5.3 | 13.1 | 15.7 |
| M86900 | MODULAR FIELD KITCHEN | | | 11.6 | 15.2 |
| MA9500 | DIVING EQUIPMENT | .7 | .4 | 1.8 | 3.4 |
| MA9600 | FIRETRUCKS | 8.9 | 9.0 | 16.0 | 13.7 |
| M90900 | HEATER DUCT TYPE, 250K/400K BTU | | | | 4.8 |
| M87600 | LAUNDRY UNIT/TRL MTD | 2.6 | | 7.3 | 7.0 |
| MB2000 | TAG PRINTING AND BINDING EQUIPMENT | 4.6 | 5.4 | 4.3 | 5.2 |
| ML5325 | ITEMS LESS THAN $2.0M (CSS-EQ) | 14.0 | 8.7 | 11.3 | 20.7 |
| MA8100 | MODIFICATIONS OF IN SVC EQUIPMENT (CSE) | 1.4 | 3.8 | 8.9 | 5.0 |
| | COMBAT SERVICE SUPPORT EQUIPMENT TOTAL | 48.4 | 47.4 | 106.5 | 105.4 |
| | PETROLEUM EQUIPMENT | | | | |
| M19000 | TANK ASSEMBLY FAB COLL POS 50000G | 2.2 | 5.1 | 4.6 | 4.4 |
| M64000 | FORWARD AREA REFUELING EQUIPMENT | | | 2.8 | 3.0 |
| M64900 | TANK ASSEMBLY FAB COLLAPSIBLE 10K G | 10.8 | 5.8 | 6.6 | 7.9 |
| R21400 | TANK ASSEMBLY FAB COLL, 20K GAL POL | | | 6.3 | |
| M62300 | TANK/PUMP UNIT LIQ DISP F/TRK MOUNTING | 12.6 | | 1.0 | 5.9 |
| M73300 | LABORATORY, PETROLEUM, SEMI-TRLR MTD | | | 3.2 | 3.6 |
| M63900 | PUMP ASSEMBLY LIQ GAS WHL 4 IN OUT 350GPM | 3.1 | 5.8 | 12.2 | |

OTHER PROCUREMENT , ARMY

| SSN | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| M12700 | PUMP CENTRIFUGAL 4X4 DED | 7.6 | | | |
| MA0260 | PIPELINE FOR TUSA | 22.0 | | | |
| MA5120 | SWA PETROLEUM DISTRIBUTION | | 38.9 | 39.3 | 43.4 |
| ML5330 | ITEMS LESS THAN $2.0M (POL) | 2.1 | 3.5 | 6.7 | 3.4 |
| | PETROLEUM EQUIPMENT TOTAL | 60.3 | 59.1 | 82.7 | 71.6 |
| | WATER EQUIPMENT | | | | |
| M16600 | WTR PUR UNIT REV OS 3000 GPH (ROWPU) | | 14.0 | 33.9 | 21.4 |
| M18000 | WATER PUR UNIT, REV OSMOSIS, 600GPH | 10.6 | 24.0 | 29.5 | 36.8 |
| M13500 | WATER STOR AND DIST SYS 800K GAL | 3.3 | | | |
| M13300 | WATER STOR DIST SYS 1.0M GAL | 1.1 | | | |
| M27400 | TACTICAL WATER DISTR SYS | 8.6 | 8.3 | | 8.6 |
| M18100 | FWD AREA WTR POINT SUP SYSTEM | 4.6 | | | |
| M66000 | TANK, FABRIC, COLL, WTR, 3K GAL (SMFT) | 1.0 | | | |
| M15000 | TANK, FAB, COLL, 3K GAL WATER (ONION) | | | 2.9 | |
| M14100 | TANK, FABRIC, COLL, WTR, SEMI-TRLR MTD 5M | 2.2 | 1.6 | | |
| M15700 | SMALL MOBILE WATER CHILLER (SMWC) | 2.8 | 2.2 | 1.5 | |
| R01400 | DRILL MACH, WELL 600FT | 1.5 | | | |
| M15900 | PUMP CENTRIFUGAL 65GPM | | 3.4 | 2.1 | |
| ML5335 | ITEMS LESS THAN $2.0M (WATER EQ) | 6.1 | 1.9 | 2.5 | 4.8 |
| | WATER EQUIPMENT TOTAL | 41.7 | 55.4 | 72.4 | 71.6 |
| | MEDICAL EQUIPMENT | | | | |
| MB9700 | DEPLOYABLE MEDICAL SYSTEM (DMS) | 52.1 | 96.7 | 88.8 | 98.6 |
| MA8045 | CBT SUP EQUIP MEDICAL | 50.6 | 98.7 | 48.1 | 53.6 |
| MA9900 | MEDICAL SUPPORT EQUIPMENT | 49.8 | 83.9 | 70.8 | 104.6 |
| | MEDICAL EQUIPMENT TOTAL | 152.5 | 279.3 | 207.7 | 256.8 |
| | MAINTENANCE EQUIPMENT | | | | |
| M61500 | SHOP EQ CONTACT MAINT TRK MTD (MYP) | 20.4 | 27.0 | | 12.2 |
| M61500 | SHOP EQ CONTACT MAINT TRK MTD ADV PROC | 36.6 | | | |
| M61900 | SHOP EQUIPMENT, ORG REPAIR, TRK MTD | 19.9 | | | |
| M67000 | WELDING SHOP, TRAILER MTD | 10.0 | 9.8 | 9.7 | 9.8 |
| M61600 | SHOP EQ ELECTRICAL RPR SEMI-TRLR MTD | 6.0 | 13.5 | 14.5 | 9.6 |
| S60000 | STEAM CLEANER | | | 5.0 | 10.4 |
| M63300 | E WELDING MACHINE ELEC ARC 350AMP (CC-CP) | | | 5.7 | |
| MA9160 | BUILDING, PRE-FAB, RELOCATABLE | | | 1.2 | 1.2 |
| MA0460 | CALIBRATION SET SUPPORT | 10.0 | 7.7 | 12.7 | 12.7 |
| ML5345 | ITEMS LESS THAN $2.0M (MAINT EQ) | 9.5 | 9.5 | 10.3 | 10.9 |
| | MAINTENANCE EQUIPMENT TOTAL | 112.4 | 67.5 | 59.1 | 66.8 |
| | CONSTRUCTION EQUIPMENT | | | | |
| R03800 | GRADER, ROAD MOTORIZED, HVY, 6X4 (CCE) | 10.4 | | | |
| M06400 | LOADER, SCOOP TYPE, DD 4WHL, 2-1/2 CU YD | 4.0 | | | |
| M06100 | TRACTOR FULL TRACKED LOW SPEED DD MED | 11.9 | 26.4 | 73.6 | |
| R04800 | SMALL EMPLACEMENT EXCAVATOR (SEE) | 28.2 | 25.3 | 25.0 | 36.3 |
| R05000 | CRANE, WHL MTD, HYDRAULIC 7 1/2 TON | 25.7 | | | 14.2 |
| M09800 | COMPRESSOR, AIR ROTARY, 250 CFM, 100 PSI | 14.0 | | | |
| MA8300 | MODS OF IN SVC EQUIP (CONST EQUIP) | | | .1 | .2 |

OTHER PROCUREMENT , ARMY

| SSN | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| ML5350 | ITEMS LESS THAN $2.0M (CONST EQUIP) | 2.0 | 6.0 | .7 | 6.6 |
| | CONSTRUCTION EQUIPMENT TOTAL | 96.2 | 57.7 | 99.4 | 57.3 |
| | RAIL FLOAT CONTAINERIZATION EQUIPMENT | | | | |
| M34200 | LANDING, CRAFT, UTILITY | 15.7 | 22.9 | 29.3 | 25.2 |
| M44600 | TUG INLAND AND COASTAL WATERWAYS | | | 30.1 | |
| M11200 | LOGISTIC SUPPORT VESSEL (LSV) | 20.2 | | 19.9 | 19.7 |
| R09800 | RO/RO DISCHARGE PLATFORM | 11.6 | 11.2 | | |
| R97500 | CAUSEWAY SYSTEMS | 13.5 | 12.9 | 28.8 | 21.6 |
| MA4029 | ARAPAHO | | 5.0 | | |
| M39500 | RAILWAY CAR, TANK, POL, 20000G | | | 9.8 | .1 |
| M37300 | RAILWAY CAR, FLAT, 140 TON | 12.8 | | | |
| M92000 | SHIPPING CONTAINER | 1.9 | | | |
| MA8950 | MODIFICATIONS OF IN-SVC EQU (FLOAT/RAIL) | 7.4 | 1.0 | 5.7 | 13.6 |
| ML5355 | ITEMS LESS THAN $2.0M (FLOAT/RAIL) | .5 | 4.2 | 1.0 | 3.4 |
| | RAIL/FLOAT CONTAINERIZATION EQUIP TOTAL | 83.6 | 57.2 | 124.0 | 83.6 |
| | GENERATORS | | | | |
| MA9800 | GEN AND ASSOCIATED EQUIP | 104.1 | 90.0 | 115.9 | 115.2 |
| | GENERATORS TOTAL | 104.1 | 90.0 | 115.9 | 115.2 |
| | MATERIAL HANDLING EQUIPMENT | | | | |
| X50000 | TRUCK, FORK LIFT, CBD, PT, 4000 LB | 7.6 | | 13.3 | 12.6 |
| X51100 | TRUCK, FORK LIFT, CBD, PT, 6000 LB | 3.5 | 13.5 | 12.3 | 10.6 |
| M48400 | TRUCK, FORK LIFT, GE, SRT, 2000 LB | | 2.9 | | |
| M48800 | TRUCK, FORK LIFT, DE PT, RT 10000 LB | | | | 33.7 |
| M48900 | TRUCK, FORK LIFT, DE, PT, RT, 6000 LB | .1 | | 21.0 | 28.4 |
| M49300 | TRUCK, FORK LIFT, ELEC, SRT, 6000 LB | 2.8 | 4.6 | | |
| M41100 | TRUCK, FORK LIFT, ELEC, SRT FRT/SIDE LDR | | 2.0 | | |
| M49200 | TRUCK, FORK LIFT, ELEC, SRT 4000 LB | 4.4 | 12.9 | 1.7 | |
| X00900 | 65 TON CRANE | | 6.2 | 42.6 | 42.7 |
| ML5365 | ITEMS LESS THAN $2.0M (MHE) | 3.4 | 5.0 | 2.4 | 8.0 |
| | MATERIAL HANDLING EQUIPMENT TOTAL | 21.8 | 47.1 | 93.3 | 136.0 |
| | OTHER SUPPORT EQUIPMENT | | | | |
| MA0350 | SPARES AND REPAIR PARTS (OTHER) | 34.2 | 37.7 | 54.4 | 55.6 |
| MB7000 | BASE LEVEL COM'L EQUIPMENT | 36.8 | | | |
| MB2100 | AREA ORIENTED DEPOT UPGRADE | 37.4 | 83.2 | 60.5 | |
| MA5550 | PROD ENHANCING CAPITAL INVEST PRGM | 2.9 | | | |
| MA5500 | QUICK RETURN ON INVESTMENT PROGRAM | 15.0 | | | |
| MA5730 | PROJECT RESHAPE (HQ DARCOM) | | 6.0 | | |
| MA0450 | PRODUCTION BASE SUPPORT (OTHER) | 6.5 | 7.9 | 34.4 | 12.0 |
| MA5600 | OSD PRODUCTIVITY INVESTMENT FUNDING | .9 | | 4.9 | |
| MA6700 | SPECIAL EQUIPMENT FOR USER TESTING | 14.1 | 11.2 | 13.3 | 18.0 |
| ML5390 | ITEMS LESS THAN $2.0M (OTHER SPT EQ) | .6 | .6 | 1.0 | .9 |
| MA5175 | HOST NATION SUPPORT - EUROPE | 17.7 | 41.0 | 41.9 | 18.2 |
| MA6600 | NATIONAL TRAINING CTR SUP | | 13.3 | 10.8 | 5.0 |
| MA1300 | SWA STAGING BASES | | 6.4 | | 6.2 |
| NA0100 | TRAINING DEVICES, NONSYSTEM | 139.9 | 177.8 | 186.1 | 235.4 |

OTHER PROCUREMENT , ARMY

| SSN | ITEM NOMENCLATURE | FY85 | FY86 | FY87 | FY88 |
|---|---|---|---|---|---|
| MA9996 | SPECIAL PROGRAMS | 42.9 | | | 16.2 |
| MB7101 | BCE (NCMI) | | | 61.6 | 42.5 |
| MB7102 | PECIP (NCMI) | | | 6.5 | 7.4 |
| MB7103 | QRIP (NCMI) | | | 9.1 | 10.3 |
| | OTHER SUPPORT EQUIPMENT TOTAL | 348.8 | 385.1 | 484.5 | 427.7 |
| | OTHER PROCUREMENT, ARMY, TOTAL | 4890.7 | 5240.3 | 6169.0 | 7189.9 |

Mr. **Darden**. Let's recess until tomorrow afternoon at 2 o'clock, and we will resume at that time.

[Whereupon, at 4:05 p.m., the subcommittee was adjourned to reconvene at 2 p.m., Thursday, March 6, 1986.]

# ARMY RESEARCH AND DEVELOPMENT PROGRAMS, BUDGET

House of Representatives,
Committee on Armed Services,
Research and Development Subcommittee,
*Washington, DC, Thursday, March 6, 1986.*

The subcommittee met, pursuant to call, at 2:20 p.m., in room 2212, Rayburn House Office Building, Hon. Charles E. Bennett presiding.

Mr. Bennett. We will come to order. Due to the fact that some members are absent—they expect to be here later to talk about different things—I think if we went into antitank activity now, that would be what we would like to go into. Then you can come back to whatever else you were expecting to do first.

## FURTHER STATEMENTS OF JAY R. SCULLEY, ASSISTANT SECRETARY OF THE ARMY FOR RESEARCH, DEVELOPMENT AND ACQUISITION, DEPARTMENT OF THE ARMY, AND LT. GEN. LOUIS C. WAGNER, JR., USA, DEPUTY CHIEF OF STAFF FOR RESEARCH, DEVELOPMENT AND ACQUISITION, DEPARTMENT OF THE ARMY

General Wagner. Yes, sir, I can discuss some of the antitank systems. I cannot discuss some of the munitions in open session in the tank arena.

Mr. Bennett. We aren't closing this yet.

General Wagner. No, sir, we haven't had to so far. We will go to the Advance Antitank Weapons System, Medium (AAWS-M), if we may go to that chart first.

### Advanced Antitank Weapon System—Medium (AAWS-M)

Medium Manportable Antitank System to replace Dragon.
Provides "light forces" with means of killing tanks.
Acquisition strategy includes 24 month "technology demonstration".
Contractor teaming required during 36-month full scale development phase.
"Tech-Demo" contract award FY 86: 3-4 contractors.

During the last several years, Mr. Chairman, we have been looking for some way that we can replace the Dragon antitank system that we have today, which is that medium system that is carried by the individual infantryman. We have been looking for a system that would weigh about 35 to 45 pounds, but would have the lethality to destroy the tank on the battlefield that we expect to see in the 1990s and up to the year 2000, called [deleted].

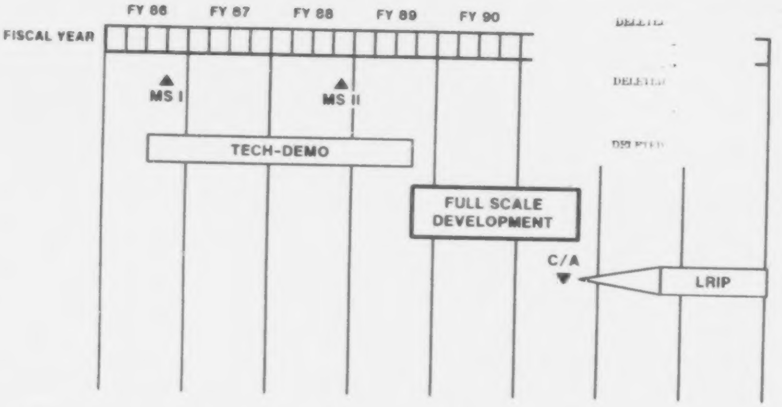
There has been much controversy surrounding whether or not technology gives us the capability of killing this particular target. So we have not only looked in our own laboratories at what is available, we have also gone out to the Department of Energy and had their scientists take a look at what is in warheads, in guidance systems, and so forth, and to see if there is a way of getting at that threat.

We believe there is, so we are ready to move forward on this program this year. We had dollars appropriated in fiscal year 1986 and prior, and we are asking for $48.7 million this year on the program. We have recently completed an Army Systems Acquisition Review Council meeting on it, and have the decision to go ahead. We will be going to the DSARC, or the Defense Systems Acquisition Review Council meeting, the first part of April to get the go-ahead on this particular program.

### DEFENSE SYSTEM REVIEW OF AAWS-M

Would you give me the next chart.

**ADVANCED ANTITANK WEAPON SYSTEM - MEDIUM (AAWS-M)**



We structured this program a little bit different than the normal one, as you can see, in that we are going to have a technical demonstration on the front end. What we are going to do here is go out with a request to industry in what we call a Request for Information (RFI), and ask them to come in with proposals as to solutions to this problem.

We know that there are several different solutions out there. For example, you could use a laser beam rider, which would use a flat trajectory weapon. You could actually use a trajectory weapon that flew up and came into the top of the enemy tank, which is one of his softest spots. Obviously that second approach is more expensive. If you are going to use that, you have got to have a higher probability of kill, so that you would need a lesser number of weapons if it is cost effective.

What we want to do then, in a period of 24 to 27 months, is to fly those systems and determine whether they will penetrate the threats that we expect to see during that period. If it proves the thesis that we believe is true, then we will be ready to make the decision to go into full-scale development followed by a low rate initial production and IOC in about [deleted]. That seems like a long time, and it is. But we are afraid if we don't do that tech demo on the front end we are not going to have the information we need to make a good decision when we get to go into full-scale development.

That was the final program we came up with as we went to the ASARC and got approval, and that is what we are recommending to you for your approval at this time.

Mr. BENNETT. That is also consistent with the Packard Commission report.

General WAGNER. Yes, sir.

Mr. BENNETT. That you get good information early on.

General WAGNER. Yes, sir. We did come up with this particular scheme before the Packard Commission Report, but that is exactly what they are recommending, that is true, sir.

Mr. BATTISTA. General, we may have to cut $5 billion, $6 billion, $9 billion from the defense budget. No one knows right now because we are pending word from the Budget Committee, but one would ask if we could really afford to do this.

You discussed yesterday the fiber optic guided missile, and if you are worried about penetrating a particular section of the tank based on the future threat, it seems to me like you have a great deal of flexibility coming in at whatever aspect you desire within the laws of physics. Why don't we just make the FOG-M, the AAWS-M, and compete that program in the industry right now and save ourselves a great deal of research and development dollars?

Within the interim we have got, certainly, other alternatives, and as I view this, it is far more critical to have an AAWS-M that will penetrate and an AAWS-H, because the consequences are ever so more severe if you don't penetrate or kill them with the AAWS-M, that is kind of your last-ditch attempt. Can we really talk about obviating an expensive R&D program and committing to a competitive FOG-M with this mission?

### AAWS-M CANDIDATES

General WAGNER. I believe that a FOG-M has a capability on the heavy side. We are looking here at a weapon with a night sight that is going to weigh 35 to 45 pounds.

Mr. BATTISTA. We can give you that with the FOG-M.

General WAGNER. The people at Missile Command believe that system would be too heavy. If I want to go to a two-man crew and have one of them carry the console, perhaps, and the other one carry the system to launch, it could be done. But we are looking for a single-man portable system to do the job, and we just can't do that in the weight limits, with the FOG-M. That is one of the possible technologies they can come in with if they can get the weight down, but it is going to be tough.

The highest priority deficiency we have in our light forces today, is a weapon that will kill a tank that the man can carry on his back. That is what the light infantryman is going to be doing, particularly if he goes into cities. In areas like that, he has got to have some kind of a system that he can carry on his back, and that is what the AAWS-M is.

Mr. BATTISTA. Two things. If we could convince you that you could get a fiber-optic guided bird under 35 pounds, one-man operation, would you be willing to use that as the AAWS-M candidate?

General WAGNER. Absolutely. As I say, we are going to look at, up to four candidates, and if they can do that, that obviously is one of the technologies.

Mr. BATTISTA. I am talking about in the next few months. I am not talking about it in say a 2½ fiscal year program to do an evaluation. If we can sit down and show you drawings that indicate this could be done in 35 pounds or less, with a one-man operation, could we commit to that and just have industry compete for the FOG-M?

General WAGNER. I wouldn't rule that out, but the people that designed the FOG-M have told me they can't do it, and I want to see more than paper. If they can do it, we would certainly be willing to look at it.

Mr. BENNETT. Don't the allies have something like this?

General WAGNER. There are several available, sir.

Mr. BENNETT. Then why are we——

### MILAN-2

General WAGNER. We are looking at those too. In fact, we are running a test right now on a French system, the MILAN-2, that would probably be an interim system. It does have some deficiencies. We believe it can take the tank on the battlefield today. As we get into the 1990's we have got to have something more lethal to be able to penetrate.

Mr. BENNETT. Senator Nunn on his side and myself on this side introduced legislation which passed in the last Congress, having to do with cooperation with NATO. Isn't this an ideal place to cooperate?

General WAGNER. That is absolutely right, sir., and the MILAN-2 that I just mentioned is one that we are going to test. If they have anything else in the marketplace, they can come in and bid it also when we go out on the street. There is a Swedish system, for example, that may have this capability.

Mr. BENNETT. It looks like we will build on top of what your allies have rather than start from scratch on this kind of a weapon. It looks to me like this is somewhat of an ideal weapon, since we are already somewhat in it whether you couldn't just help them cooperatively or something like that.

General WAGNER. I think that is a definite possibility, sir. In fact, this could well turn into that, if we don't have anything, when they come back with their proposals that can do the job. The current ones will not do it.

Mr. BATTISTA. That is by choice, not by necessity.

General **Wagner**. It is if you want to penetrate the future threat.

Mr. **Battista**. Let's worry about those 45,000 tanks we have out there today. We are always reaching for the proverbial better carrot. Mr. Bennett asked for hearings on conventional defense initiatives, I guess in December, and at the last hearing on testing I pointed out in response to your request, I agreed wholeheartedly with the Washington Post article that we haven't done anything for the infantryman since World War II that gives him the capability with the threat.

We had bazookas bouncing off T-4's in Korea, and we are always talking about how good we are in the next generation threat. I will give you an example.

MILAN-2 has been offered to you for $7,000 a copy from fixed price, and that would breach that gap between 1986 and 1989.

General **Wagner**. That is exactly right.

Mr. **Battista**. Right now.

### MILAN-2 TESTING

General **Wagner**. And we are testing it right now.

Mr. **Battista**. I don't understand something, though, General. The Europeans have fired 26,000 rounds of MILAN-1 and 2. The success rate is 95 percent through [deleted] of armament. What is there to test?

General **Wagner**. They have modified it, as you know, considerably, recently, and we are looking at their test data plus the ones we have fired, to see if all of their claims are true. We are not putting that one off. We are firing it, as you well know. That is one of our initiatives.

Mr. **Battista**. Let's look in terms of a cohesive strategy.

General **Wagner**. In closed session I can tell you some more about it that I can't give you here in open session.

Mr. **Battista**. But let's switch now, if we are going to do that, and we have got a FOG-M that may be a heavy candidate with the prospect that it could be medium as well, and I will not sign up to that right now, granted that we have concerns that you have raised that should be addressed, but we can't afford to do it all.

Why spend all that money in proving Dragon, which basically can only hit a target, if the target would inadvertently fly into it. I have seen all the recent test results on the Dragon. It is a nightmare. Up until last year you agreed that it was a nightmare. Not you, the Army. And now we are going to pump all these millions of dollars into a Dragon upgrade which when we get done amounts to taking the nameplate, putting a new bird under it, and as far as capability it is still a Dragon.

General **Wagner**. That is not this program.

Mr. **Battista**. No.

General **Wagner**. And we are not——

Mr. **Battista**. What I am saying is we have got to look at a roadmap.

## DRAGON PRODUCT IMPROVEMENT PROGRAM [PIP]

General **Wagner**. I agree. We are not buying into any major overhaul of Dragon. If there is a cheap warhead PIP, we may put that on. We are not looking at a total Dragon Product Improvement Program as another service is that it is essentially building a new missile and calling it Dragon.

Mr. **Battista**. That is still only a fraction of the problem.

General **Wagner**. I agree, and that is the reason we feel it is not worthwhile to spend many dollars on Dragon because of its accuracy and the difficulty of training with it.

Mr. **Battista**. How much money is in the budget this year for Dragon Product Improvement [PIP], the upgrade? Have you taken it out yet?

General **Wagner**. No, I think there is some in there, some procurement dollars. I will find that and provide it to you.

[The following information was received for the record:]

### Dragon

No, we have not taken it out yet. The Army has $2.5 million in the FY 86 RDTE budget and $4.7 million in the FY 87 procurement budget.

Mr. **Battista**. The Marine Corps is spending how much?

General **Wagner**. They are the ones doing it in R&D and I don't know their total R&D.

Mr. **Battista**. Those are big dollars.

General **Wagner**. They are saying small dollars.

Dr. **Sculley**. That would allow us to retrofit up to 20,000 missiles at an estimated cost of $1500 per missile, but clearly that it is but an option. I am not at this point signed up to it.

Mr. **Battista**. Along the lines that Mr. Bennett is interested in, is there any way you could assure the committee that you are going to deploy a contemporary capability between now and the end of fiscal year 1987, be it the MILAN or whatever, to give the infantry guy out there something to go with in lieu of what he has got now?

General **Wagner**. We will be deploying something, and I can't guarantee at this point whether it will be that Dragon warhead or whether it will be some MILAN's for some of the early deploying forces. That is what we would be looking at, perhaps for the 82d Airborne, and for the Ranger units—a limited buy, something in the interim for them.

Mr. **Bennett**. Let me urge you, to the extent that you can influence it, that you give thought to what we did pass in the last Congress.

General **Wagner**. Yes, sir.

Mr. **Bennett**. About cooperating with NATO, particularly since it is just an interim purchase. As long as we are getting something at a comparable price, and we are cooperating with them under that substitute.

General **Wagner**. That is right.

Mr. **Bennett**. Which is something that we do want to push forward, because it has a lot to do with having their cooperation.

General **Wagner**. No question about it.

Mr. **Bennett**. I hope you will try to do it.

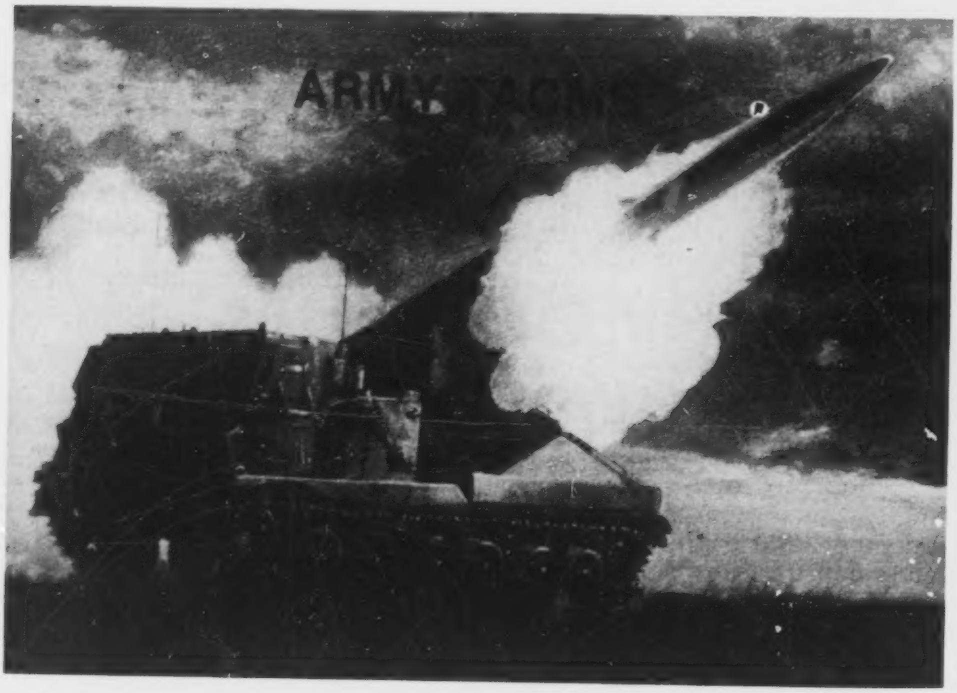
General **Wagner**. Yes, sir. Do you have any more questions on that one?

Mr. **Bennett**. I have no further questions. Any other weapon?

General **Wagner**. That is the only antitank weapon I can discuss in open session, but we can go on to the Army tactical missile system now, if you would like to do that.

Mr. **Bennett**. All right, sir.

General **Wagner**. Give me the next chart.



When you were not here yesterday, I explained one of our greatest deficiencies on the battlefield today is to give the corps commander the capability of being able to strike the enemy at ranges perhaps [deleted] deep, not to win the battle at that point, but be able to cause him enough problems so that you destroy his timetable and have a better chance of beating him at the front lines. One of the key deficiencies in that area is the attack system to do it.

### ARMY TACTICAL MISSILE SYSTEM (ATACMS)

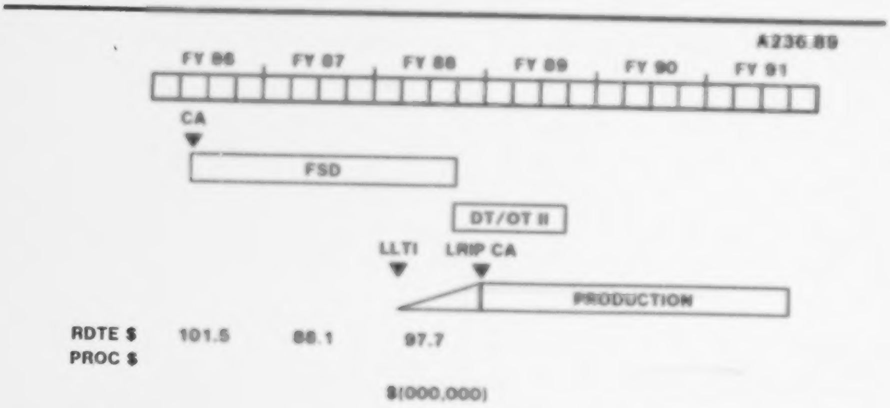
The one that we want to do it with is the Army Tactical Missile System.

What we have done is taken the MLRS chassis, which is proven and is proliferated on the battlefield today. We will package within what is now called a six-pack with the multiple launch rocket system rockets in it, and put a missile in each so that we will have two of these missiles per launcher. We are really doing this in a block approach. The first block will be an antipersonnel and antimateriel system or APAM warhead, which can go after softer targets. It is not going to destroy tanks out there.

A second block, perhaps for this missile or another program, would be to put in smart munitions that could go after tanks, but that is a little bit farther down the pike, because we are looking at getting this out in the field within the next 4 to 5 years.

Would you give me that next chart.

**ARMY TACTICAL MISSILE SYSTEM**



This is our program that has been approved by the Defense Systems Acquisition Review Council. We are going into full-scale development on an accelerated program. We will actually make a longlead time decision here at the beginning of fiscal year 1988, and then build up in an LRIP production so that we can run a development test, and operational test on it.

## ATACMS FULL-SCALE DEVELOPMENT

We are going to fire in this full-scale development program initially 25 missiles during the manufacturing process, similar to what we did in the Pershing program. If those go well, then we will go into the operational testing, and fire 10 more.

However, sometimes you run into problems as we found in the past, so we have put in an additional 15. If it is absolutely required, we could fire them and slip this program slightly.

So that is the reason, I would like to point out, that this is an event driven program as opposed to some of the programs in the past that were schedule driven. Although we show it very accelerated, it is going to be driven, so if we run into a problem at any point and have to make minor changes in the missile we can do it.

If we do not, we can move according to this schedule and then go into a rapid buildup and production of these missiles. We have our RFP on the street. We have two manufacturers that are bidding on this program, and we hope to make the selection next month, and then let the first contract and move out on this one.

We will bring along a second source so that we can compete it if we later decide to build any more past the first buy. If not, it would be a limited buy and we would probably have a single manufacturer.

Mr. BATTISTA. What do you have on this one?

General WAGNER. The two that will be in competition are Boeing and LTV. It will probably be close to 22 inches, somewhere in that ballpark.

Mr. BATTISTA. This would be a new one, of a Lance derivative or what?

General WAGNER. It is probably a new missile, although you would like to say you take components off of other missiles, which we have done, with both of these. But as far as saying you have just taken a Lance and tucked it in there, that is not true, because it has different guidance, as you know, for more accuracy. It has a larger warhead on it so it has to have a bigger motor.

Dr. SCULLEY. It is essentially the same that was used as an assault breaker. I would also point out that the development contract is fixed price in nature, and the production options are a fixed price not to exceed.

Mr. BATTISTA. Can you give us the development cost on the not-to-exceed?

### ATACMS COST

Dr. SCULLEY. Our estimates in RDT&E are $760 million, and if in fact we limit the buy to a thousand, we expect the cost in procurement to be about $840 million on the outside.

Mr. BATTISTA. Wouldn't in fact you have a much lower proposal from at least one of those?

Dr. SCULLEY. This discussion is really in the absence of any knowledge of the proposals, we are in the source selection process now.

Mr. BATTISTA. Wait a minute. We go competitive to save money, but before you had this—now it is going to cost us $750-plus million to develop, and before that I thought we had a single source offering you the whole system for less than $500 million. I mean the objective of competition is not to spend 50 percent more. So you had a sole source that was a lot cheaper. Recognizing that as a production option, you can certainly take that sole source technical data package and compete it. It sounds like we took a $500 million program and drew it to $1.5 billion.

General WAGNER. The one you are talking about is one of the bidders, and if they come in with a cost that is well under the others, they are going to win, there is no question about it.

Mr. BATTISTA. You already did.

General WAGNER. We are committed now, as you know, the prior year dollars, fiscal year 1986, is $100 million plus the $88 million in this year's, fiscal year 1987, budget.

Dr. SCULLEY. A Government estimate, again, which I feel is the best we can do, but in fact there is no question that in some programs we have over estimated.

Mr. BATTISTA. I just don't understand how you had an unsolicited proposal for *x* dollars and we went competitive and now we have a total program estimate of $3X dollars.

General WAGNER. There is a difference between the total system too.

Dr. SCULLEY. That is right.

General WAGNER. It didn't include the total warhead development and testing.

Mr. BATTISTA. You are developing another warhead?

Dr. SCULLEY. Their proposal did not include the total warhead development.

General WAGNER. It was not included in there.

Dr. SCULLEY. It is a $400 million——

Mr. BATTISTA. This is off-the-shelf ordnance.

Dr. SCULLEY. If I recall, this is a $400 million offer by Vought, but did not include moneys for warhead development.

Mr. BATTISTA. How much is in here for the warhead?

Dr. SCULLEY. That I don't know but I will be glad to provide it for the record as to what was for the missile and what was for the warhead.

[The following information was received for the record:]

### ARMY TACTICAL MISSILE SYSTEM

Warhead development and test costs are the order of $7–10 million but this is only one small area where baselines differ between the LTV offer and our current government estimate. The LTV offer was based on constant FY 85 dollars while our estimate is based on then year dollars. LTV's offer did not include government costs such as system program management; range support costs; or the cost of government furnished equipment such as launchers or munitions to support the development effort. The government estimate does include these items.

General WAGNER. This also includes the modification of the L on the MLRS. It includes the software for that. It is the total package. The other one is not the total package. That is where we have to get those two together, and that is what they are doing in source selection right now to see if there is a major difference between them.

Mr. BATTISTA. I may be wrong but when I saw that it was total package less the warhead—and I am not sure your numbers have the warhead here——

General WAGNER. Yes.

Mr. BATTISTA [continuing]. I still don't understand whether you are developing a new warhead or using an off-the-shelf warhead.

General WAGNER. We are using bomblets off the shelf in this one. The initial munitions will be off the shelf.

Mr. BATTISTA. You are not developing them?

General WAGNER. Not the submunitions.

Mr. BATTISTA. There is a warhead——

General WAGNER. Just the frame and mechanics of it.

Mr. BATTISTA. Right. So we are still going from X to 3X.

General WAGNER. I don't think so. We can't really argue that until we see what their bids are and what are all of the pieces that go with it, because it is, as I said, there are some modifications that have to be made on the launcher. There are other overhead costs and provisions for the Government management. We have to crank all that in and that is what they are doing in the source selection. When we get those dollars we will come and show them to you. We are not going to drive it up.

Mr. **Battista**. Perhaps we can cover that later on. We will go over the old proposal and new proposal.

General **Wagner**. Absolutely. Agreed.

Mr. **Bennett**. Mr. Darden has come, so he is now the chairman. But I would like before I turn over the gavel——

Mr. **Darden**. I yield the chair to the gentleman from Florida.

Mr. **Bennett**. I would guess this would be a place, this hearing would be a place, where you could discuss what you plan to do with regard to making the Bradley more defensible or what changes you expect to make in that, and so at some time today I would like that to be addressed. I will give this to him because he looks like he is in a better position to handle it.

### BRADLEY FIGHTING VEHICLE (BFV)

General **Wagner**. In answer to the question you asked on the last one, Mr. Bennett, this is one system that is in our NATO cooperative R&D arena in two pieces.

Mr. **Bennett**. The one you are talking about?

General **Wagner**. Yes, sir. First of all, we are looking for coproduction options on it. We will also work with them on future warhead developments if they are interested. So we are working in two arenas, and we will soon be opening discussions with them. We have already done it on coproduction and we are going to open them on different types of warheads that could be applied to it as we go on down the pike in development.

Mr. **Bennett**. Mr. Darden is in charge now.

Mr. **Darden** [presiding]. All right, sir, we are ready to proceed then with the——

General **Wagner**. Yes, sir, Mr. Darden, when we closed yesterday we were about halfway through, the LHX discussion. We waited until someone who was here yesterday came back, so if you want to we can go back to LHX and proceed from there.

Mr. **Darden**. Please.

### LIGHT HELICOPTER FAMILY [LHX]

General **Wagner**. As I pointed out, yesterday on the LHX we have an aging fleet out there. It numbers about 7,000. We are looking at replacing that with about 5,000 of a more modern helicopter in the period from approximately 1995 on past the year 2000. This is a program that we have spent considerable effort in the technology base to make sure that we have the technology in hand before we go out and try to develop something new. If it isn't any better than what we have today it wouldn't make a lot of sense to develop a new helicopter.

For example, as I pointed out, today helicopters are made of rivets and steel, 40,000 rivets on the AH-64. We are looking at a composite aircraft for the LHX so it will be a lot more survivable. We want to fly with fiber optic cables to save weight and to give it redundancy to make it more survivable on the battlefield. We want to go to one pilot. We feel that that will be a big saving, but before we can do those things, we have to develop the technology to make sure we are there. We feel that we are essentially there today.

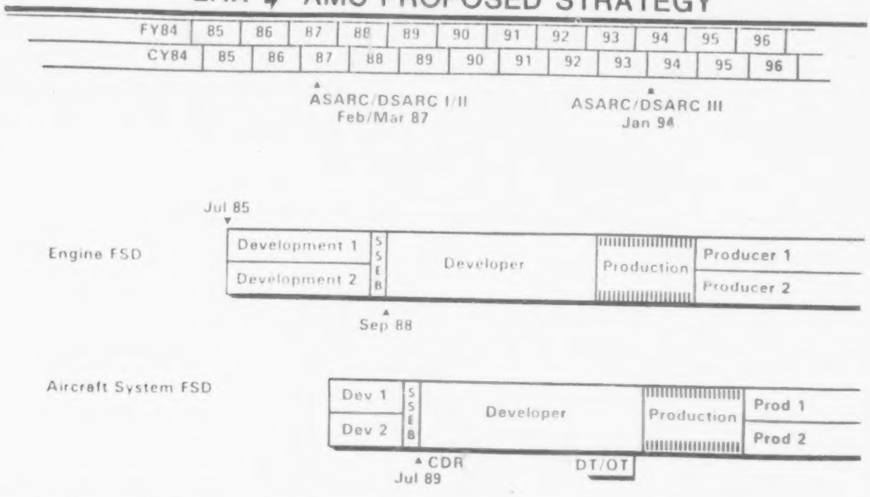
For example, in 1985 we spent $45 million in the technology base in various programs, such as the advanced digital-optical controls and advanced composite airframe programs that I showed you yesterday. We have been doing that every year to get ready to eventually go into full-scale development. In 1986 we are spending $31 million; in 1987, $39 million.

### ADVANCE ROTORCRAFT TECHNOLOGY INTEGRATION PROGRAM [ARTI]

In addition to that, the Advance Rotorcraft Technology Integration [ARTI] Program is directly applicable to this program and runs about $50 million in prior years, in 1986, $44 million plus, and the same thing this year. We are looking at the long poles in the tent to make sure that we reduced the risk before we ever go into full-scale development on an aircraft of this nature. We haven't done that in the past. In the past when we have developed an aircraft, we have gone out and said build it, and then we ran into problems in the integration of the avionics and so forth.

What we are really doing on this particular aircraft program is demonstrating upfront the key cockpit mission equipment and avionics suite, and the technology to build them, not the exact ones you are going to drop in there but the technology to make sure you can build them before we go into the development. If we find we have problems, we are going to have to make a decision, "can we do everything that we want to do on this aircraft?" I think we are taking a smart approach. In fact, Mr. Bennett, that is sort of, again, what you said the Packard Commission recommended.

LHX ➧ AMC PROPOSED STRATEGY



What we have come up with, then, is the development program you see on this chart. We are in full scale development of the engine right now. We have two teams of contractors to develop an 800-shaft horsepower engine, excuse me a 1,200-shaft horsepower engine that will give us growth potential as we go on, because sometimes in the past we haven't built that in. It is called the T-800 but it is 1,200 horsepower.

We are right here in the aircraft development now, demonstrating the avionics and so forth. We are going to make a decision prior to going into full-scale development in fiscal year 1988. What we are asking for in this year's budget is only to complete that upfront study so that we know we are on track before we ask for the dollars to go into full-scale development.

Would you give me the next chart, please.

Mr. **Darden**. General, before you go ahead, would you please address the engine with a little more specificity, where it stands, how much money you are asking on the engines.

General **Wagner**. Yes, sir. Right now in this year's budget we have $111 million. In the 1986 budget we had $69.9 million. It is on track now. Both contractor teams are doing well. We have a good competition, and we think as a result of that we are going to get a good engine with considerable savings.

### WHY CONTINUE ARTI?

ARTI proves the LHX concept and reduces risk in FSD.

ARTI work in FY 1986 includes: Wind tunnel simulation; wide field of view heads up display; electro-optical target acquisition-designation system; and preliminary air vehicle design.

Success in ARTI effort leads to a Milestone II Decision decision in March 1987.

This is what we plan on doing in 1987. We want to do wind-tunnel tests and flight and mission simulation on the actual models of actual designs of the various contractors that are working in the program. We actually have five working in that arena. We are doing a lot of work in the wide field-of-view heads-up display, absolutely essential if we are going to develop a helicopter with single pilot operation. We are working on an electro-optical target acquisition and designation system, automatic target recognition, and investigating the capability of the pilot to do that. We have to make sure that we have that capability.

Finally, we will be doing some preliminary vehicle design only in the very general sense. We feel that this approach is going to do several things for us.

In addition to giving us the background we need to make a decision, it is also going to give us the capability of coming in and saying we have a better handle on the cost of the T-800. Because as we go along, we are going to have some idea what this avionics and cockpit mission equipment package is going to cost. It is my personal view that it is going to be more expensive than the airframe. I don't think anyone would argue that. So we have got to make sure that we have a handle on the avionics package.

That means the COEA that we will be finishing up after this year will have a lot more validity. This is the first program that I can think of in the years I have been associated with in R&D that we have ever done the front-end work with a level of detail as we have on this one. We feel that it is a good way to go, and we feel that we ought to continue that through 1987, so that when we get ready to make that key full-scale development decision in 1988, we have the background to do it.

Mr. **Battista**. General Wagner, what kind of a sensitivity analysis have you done to establish what sort of a capability you have over what you have in the inventory today, in the event certain technologies don't materialize? For example, we have been working on automatic target recognition since I graduated from college, and every year we have had promises, but every year we have had to back off. We have a LANTIRN system today that does not have automatic target recognition capability in it.

General WAGNER. That is right.

Mr. BATTISTA. And the feeling is we probably won't see it within our lifetimes. You are talking about the 1991 Flight Demo Program here.

If you don't get automatic targeted recognition, how good of a system do you have? Accordingly, if you don't get single-seat capability, and you know, we haven't even seen, for example, the application of RAM coatings to armored personnel carriers, which would make the helicopter single-seat mission ever more difficult than it is today, and everybody I talk to says it is much more difficult to fly a helicopter than a fixed-wing aircraft. I don't know if that is true or not.

General WAGNER. Half of it, I would agree with you.

Mr. BATTISTA. We are really loading up the fixed-wing guys. Now, if we have these guys flying on the deck, single seat, and you have got low observable armored vehicles, it sounds like your problem is going to be very complicated. So if some of these things don't materialize, what happens?

Is it still feasible to go ahead with an LHX?

And then, second, you talk about avionics. We have got integrated electronic warfare package in the Air Force, navigation identification avionics package in the Air Force.

General WAGNER. We are working with them on that.

Mr. BATTISTA. Does ARTI assume a derivative of INEWS/ICNIA for the LHX?

### LHX AFFORDABILITY

General WAGNER. They are looking and following everything that is going on in ICNIA as to what the pay off will be in this particular aircraft. In fact, we talked to the project manager several days ago to make sure that we were working in sync with the Air Force on those so we don't spend the same money twice. There is no question on that.

In answer to your first question, that is exactly the reason we have got to get a feeling whether we can do this, and the reason, we have to see whether a single pilot is feasible or not.

If he cannot handle the load, if we have to make tradeoffs on it, the~~n that wi~~ll have an effect on the effectiveness analysis, and it is going to have an effect on whether or not it is a cost-effective aircraft. But we are not going to know that until we complete this demonstration program.

That is exactly the reason that we are doing it. As you know, there was a push 2 years ago to rush in. We would have been in full-scale development this year. I can assure you if we had been in full-scale development this year, we wouldn't have been ready, because we just have to run these examinations or the long poles, to make sure we can get there.

Mr. **Battista**. The estimates for this program were $11 billion to $75 billion depending on how many you buy over how many years. What is the Army willing to give up, seeing as how we have a Federal deficit in Gramm-Rudman and we have got to get to zero in 1991, and we can't do it all; what is the Army willing to give up in the way of antiquated aircraft or let's say high-mortgage maintenance bills for current aircraft that may be outdated, to subsidize the LHX program?

As an example, one rationale given to me for doing this was we are going to phase out the 58's. Well, we are not really doing that, because we are going to keep 568 of them in the inventory. That is your plan, to do aerial Scout. That is $4 billion worth, and in addition to that, you run into trouble with that program, you have only proven you can do one of the three missions. Are you willing to give up AHIP to get the LHX or certain product improvements of existing airframes to get the LHX so we can zero sum it and afford it?

### LHX COST

General **Wagner**. The Vice Chief of Staff has had a study of this run, looked at what aircraft procurements are going to be coming in in the mid 1990's into the year 2000, and in studying we feel that this is an affordable program with what we project will be available in those years for procurement. The dollars you quote are correct. It depends on the production rate. It depends on the total numbers.

It depends on the escalation factors. That is what makes it a nightmare. As you know, if you took 5,000, you took fiscal year 1984 dollars, it is about $40 billion. In fact, in the most recent escalation figures, it has come down from $72 billion procurement, on the high side, to about 50-something.

Those you take with a jaundiced eye. You have got to look at, I think, constant dollars and what you expect your piece of budget to be. That is really more meaningful when you get into those out years and the escalation factors. We feel that we will be able to afford it out there, and we are going to be taking a lot of aircraft out of the fleet to do it.

### AHIP

The AHIP is really not a competitor for this one, because it is available today. There is no question it didn't meet one mission. It wasn't because of the performance of the bird. It was the operational concept and how that aircraft was used, and the various training that they gave the individuals. So it just didn't show that it did a good job in the scouting. We feel that it is going to do well with proper training.

Mr. **Battista**. Let me make one last point. You say that the Vice Chief of Staff has established that, well, yes, we can afford this. Secretary Weinberger, assuming he is going to get 8-percent growth in defense this year, and by all indications he is not, the problem is going to be exacerbated, not helped, by continued cuts in the defense budget. So regardless of what your plans indicate as far as affordability, I don't think there is a way to get there from here by the time the appropriations process is completed.

You say Scout or the AHIP is not a competitor. If you can put a laser rangefinder on your designator, and you can put a wide field of view heads-up display and an E.O. target system, then indeed it is a competitor. It may perhaps not be in weight. There may be a weight differential there, but in terms of capability and cost and logistics support profile, yes, the two do compete.

General WAGNER. In the out years.

Mr. BATTISTA. In the out years.

General WAGNER. In the very far out years, right, for a single mission.

Mr. BATTISTA. Yes.

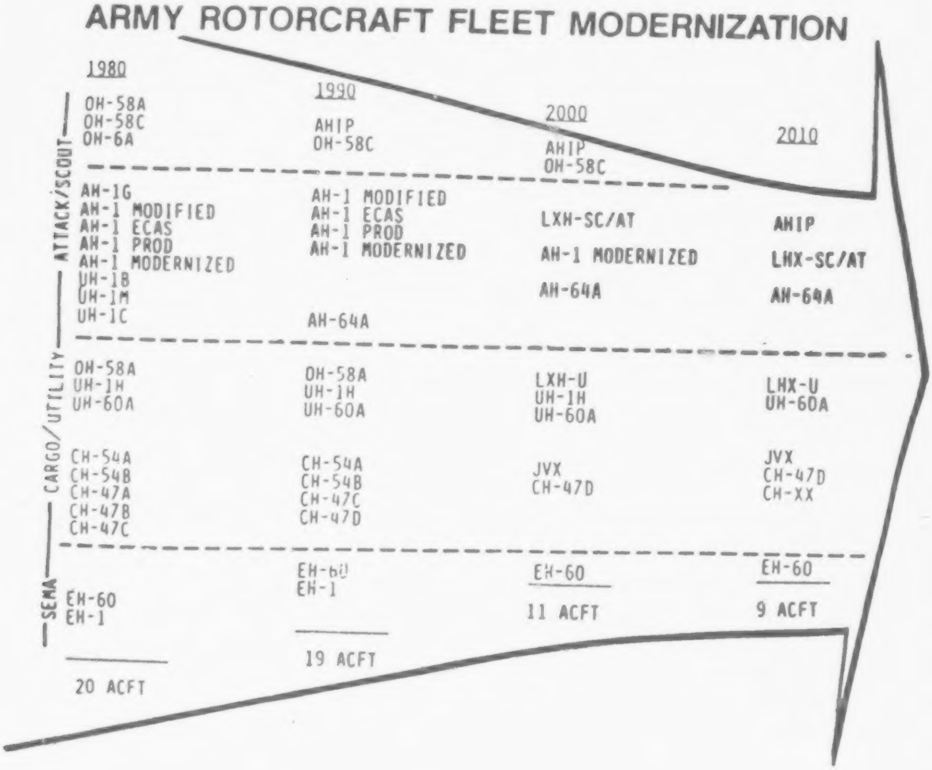
General WAGNER. Now, this is going to be a multiple-mission aircraft. It is going to replace the AH1S's, it is going to replace the Scouts and it is going to replace a lot of the smaller utility aircraft that we have with a utility version of the LHX.

Mr. BATTISTA. Do you have a vugraph showing how this would be phased out when LHX comes in?

General WAGNER. I don't have that one with me. I can provide it to you.

LIGHT HELICOPTER FAMILY (LHX)

The vugraph is provided for the record as requested.



ARMY ROTORCRAFT FLEET MODERNIZATION

| | 1980 | 1990 | 2000 | 2010 |
|---|---|---|---|---|
| ATTACK/SCOUT | OH-58A<br>OH-58C<br>OH-6A | AHIP<br>OH-58C | AHIP<br>OH-58C | |
| | AH-1G<br>AH-1 MODIFIED<br>AH-1 ECAS<br>AH-1 PROD<br>AH-1 MODERNIZED<br>UH-1B<br>UH-1M<br>UH-1C | AH-1 MODIFIED<br>AH-1 ECAS<br>AH-1 PROD<br>AH-1 MODERNIZED<br>AH-64A | LXH-SC/AT<br>AH-1 MODERNIZED<br>AH-64A | AHIP<br>LHX-SC/AT<br>AH-64A |
| CARGO/UTILITY | OH-58A<br>UH-1H<br>UH-60A | OH-58A<br>UH-1H<br>UH-60A | LXH-U<br>UH-1H<br>UH-60A | LHX-U<br>UH-60A |
| | CH-54A<br>CH-54B<br>CH-47A<br>CH-47B<br>CH-47C | CH-54A<br>CH-54B<br>CH-47C<br>CH-47D | JVX<br>CH-47D | JVX<br>CH-47D<br>CH-XX |
| SEMA | EH-60<br>EH-1 | EH-60<br>EH-1 | EH-60 | EH-60 |
| | 20 ACFT | 19 ACFT | 11 ACFT | 9 ACFT |

Dr. SCULLEY. It exists. Mr. Battista, I would point out that in the Vice Chief's presentation to the Defense Science Board group that is looking at LHX, the assumption that he used was 1-percent real growth with 3-percent inflation, which I think was conservative in nature, in making his judgment that it was affordable.

General WAGNER. This is the highest priority R&D program we have right now. We have just got to do something. There is no question that next year, as we see how the budget continues to go, it is a major decision as we go into full-scale development.

Mr. DARDEN. Excuse me, General, did I understand you to say this is the No. 1 highest priority?

General WAGNER. R&D program.

Mr. DARDEN. As far as the Army is concerned in R&D?

General WAGNER. Right.

Mr. DARDEN. Could you help us with some other priorities? Could you assign some numbers with some other programs?

Mr. BATTISTA. Two through 100.

Mr. DARDEN. Mr. Battista asks maybe 2 through 100 to tell where we are.

General WAGNER. I can do that.

Mr. BENNETT. Why don't you give your reasoning as to why this is top.

### LHX PRIORITIES

General WAGNER. Primarily, sir, because as we get into the 1990's, it is going to be one of our greatest deficiencies, particularly in the aircraft. Now, we have other high priorities, as that ATACMS that you saw. That is going to be ready to get into production long before the LHX, but as we look into the 1990's, we feel that this is our highest priority R&D program, because we don't have anything else to replace it right now.

Those birds are going to be 25 to 30 years old, as we reach that time period, and we just have to have something to replace them. We feel that the technology is available, but we have got to do our homework to make sure it can do everything we ask it to do. If it can't, we are going to have to back off some, there is no question.

Mr. BATTISTA. Why can't you replace those birds with 6 or 7 hundred more Apaches and Blackhawks?

General WAGNER. If I replace them with that, I am going to have, into the year 2015, nothing built of new technology in my fleet beyond the 1970's technology. I am still going to be riveting. I am still going to be using bell cranks, I am still going to use high maintenance factors, manpower-intensive aircraft, no built-in diagnostic right into the out years, 30 years into the future.

Mr. BENNETT. That is using the last generation approach, but for example in the advance tactical fighter program, the Air Force, part of the Air Force has agreed with our assessment that in this day and age it is most important to take these microelectronics and the engine and wrap an airframe around it. The airframe is the shortest pole in the tent, and I would wonder if we had an airframe. If we had the microelectronics, why, we couldn't wrap an all-composite Blackhawk or an all-composite Apache, or any other airframe around those avionics, so I disagree.

General **Wagner**. I can do that. But I am not sure I will come up with anything cheaper if I take a new avionics package, new fly-by-wire package, and put a new composite airframe around it.

I am not sure it will be any cheaper than what I have here.

Mr. **Battista**. If you believe learning curve figures, we are down the learning curve on the Apache, down the learning curve on Blackhawk, now the electronics, the ICNIA, INEWS, all that is coming along.

This program will require what, $3 billion at the least for RDT&E?

General **Wagner**. About that.

Mr. **Battista**. You can buy a lot of hardware for $3 billion.

## AIRCRAFTS COMPOSITES

General **Wagner**. As you described it though, that is not a Blackhawk. Or an AH-64. That is a new aircraft?

Mr. **Battista**. Not necessarily.

General **Wagner**. If I take a new avionics package, new fly-by-light and wrap a composite airframe around it.

Mr. **Battista**. If we take an A-7 and replaced the COM system with fiber optics, we still have an A-7. It is just that now we have—didn't have the expense of connections going to it. You can take a ship today and replace it with fiber optics and take away a God awful amount of weight and expense and replace it with fiber optics and functionally, you have the same system only with more reliability.

General **Wagner**. Right.

Mr. **Battista**. Right.

General **Wagner**. Those are incidentally alternatives in the COEA that are being considered. Do you have any more questions on the program, sir?

Mr. **Darden**. I don't believe so, General.

Mr. Bennett, anything further?

Mr. **Bennett**. No, I don't have on this. I thought sometime today, you might get to what you expect to do about upgrading the Bradley.

## BRADLEY MODIFICATIONS

General **Wagner**. As you know, Mr. Bennett, on the Bradley, we have had an upgrade program in our technology base, and also in the program for a number of years now, looking at various new types of armor, composite armors, looking at the KEVLAR blankets inside and so forth.

As we run tests that will begin in March, and we are just going final on that test plan with the Department of Defense right now. We will make the final decision as to what modifications we want to apply to the Bradley.

Most of the R&D work has been done. It is the matter now of integrating it into the old vehicle. In fact, we are putting together vehicles right now that have a KEVLAR blanket in them. We will have two types of applique armor and another vehicle that will move some of the ammunition storage outside and possibly fuel tanks outside, that is what Colonel Burton was discussing.

That will be another vehicle that we will look at. We will then make the decision, and sometime in the fall we will know which configuration of those modifications we are going to put on the Bradley.

Mr. BENNETT. I don't want to do anything that Congress doesn't have the responsibility to do in the sense I don't want to dictate to the military what they do about things, but the two things that concern me about the Bradley, first of all, are the tactics and whether or not they were really necessary to be to endanger personnel to the extent this seems to me to do.

Second, having to do with the improvements in the Bradley and frankly, all—I have been quoted several ways on the Bradley, but I never had a different opinion.

My opinion was that I had enough question in my mind to make me feel it would be a wise thing to have a program which let the things that are already contracted for be purchased, they are good enough maybe to do it for whatever tactics you are going to use it for, and then look at the improvements you want to have on it for the rest of the thousands of units that you expect to acquire. I am not trying to draw new lines, or give this committee authorization over something that is supposed to be in another subcommittee—but have it tested for those new improvements at that point to see whether or not we should go to these numbers.

My own feeling about it is that it is such a wonderful target for the enemy that I really, if my son was involved in being in this combat type, I would feel we had made too good a target and have too little protection.

Of course, if you get a lot more protection, you virtually have a tank. I would just sort of lean toward having a man on the ground with something that can kill tanks who is a much less attractive target than this thing is, have him as far forward as possible.

That would be the way I would like to have it done. I may be wrong about it. I was only in the Army 5 years, and a lot of things have been invented in the last few decades since then.

So, maybe I am wrong. But I don't like to see infantry soldiers cavalierly put in an unnecessarily dangerous position if it can be done otherwise. So, my major criticism is the tactics as I understand it, putting them too far forward with such a very fine—but attractive—target.

The other thing about it is to what extent will it change? When I add those two together, I feel like I would be content with the program that took the ones that have already been contracted for to buy them and utilize them like you want, but then take another hard look at this as to what you want to do about it in the future, and maybe buy the future numbers in other types of vehicles and do it with clearly understood tactical objectives.

Maybe that is complicated, however, it doesn't seem complicated to me. That is how I feel about it. I don't want us to get caught in an industrial complex thing where we produce them because we didn't know how to stop it.

I really don't know as I sit here now who would pass on the next testing. Packard had an idea about a place to test, but this would be an awfully good place to test and not produce all these things and say later we should have tested them better in the past.

Can you address this? First of all, the question of tactics, which is the most concerning thing to me, why do we want to put this kind of a vehicle out ahead of tanks, which are so much less vulnerable than this vehicle?

Why would you want to put them out there in this dangerous position when you could get people out there by an ordinary vehicle moving infantry and let them out on the ground because they are not as good a target in my opinion?

I don't think a truck is as good a target as this. Then that would be the way I would think I would want to do it. I may be wrong. You have been in the Army a lot longer than I, and have seen the upper view of it.

As I understand it, I have seen graphs that have been shown to us that show this vehicle out in the front of the tanks.

### BRADLEY VULNERABILITY

General WAGNER. Well, sir, that is a rare use of the Bradley when it is in front of the tanks. There are sometimes if you were exploiting with very light opposition that you may have this vehicle running with tanks. Very rarely would you have it in front of them.

About the only time you would see it in front is if there were an opportunity you could run it through a covered position to get the infantry to somewhere where they could dismount. There is no question if you put it in front of the tank, where you are subject to antitank fire, they can take it out.

Mr. BENNETT. That is what I am worried about.

General WAGNER. Just as they can take the tank out.

Mr. BENNETT. But this is an easier target, this blows up quicker, takes more people and does more damage to the opposition. So it is a more beautiful target than the ordinary tank looks like to me.

General WAGNER. Yes, sir. But every war has shown us that the tank cannot survive, as you well know, on the battlefield without the infantry.

That also means that when you have to move the infantry from one point on the battlefield to another point, you want to move them as quickly as you can, suppressing fire while you do that, so they are subject to that fire the shortest period of time to conserve the infantry.

This vehicle gives you that capability. It also gives you the capability when you are exploiting to be able to keep up with the tank, which we can't do with the M113 that we have today.

Mr. BENNETT. Why would the infantry dismount from that, all their lethal things are in there, aren't they? They don't carry that with them except maybe the O-9 or something.

General WAGNER. If you had to attack a heavily defended position composed of tanks and other antitank weapons, you would not be able to attack frontally with tanks.

Mr. BENNETT. Say that again.

General WAGNER. If you had to attack a heavily fortified position that was defended with tanks and other antitank weapons, there is no way that you can attack that frontally, moving straight into them with tanks, Bradleys, or any other weapon.

The only way you dig them out of there is to put in artillery as much as you can, other covering systems such as air strikes, and you may have to dismount the infantry and maneuver them into a position where they can dig out antitank weapons.

Mr. BENNETT. These people in the Bradley, will they have antitank weapons?

General WAGNER. Yes, sir they will. But——

Mr. BENNETT. How many on each one of the Bradleys?

General WAGNER. On the Bradley, there is the TOW missile system. It has——

Mr. BENNETT. I don't mean that. I am talking about the men.

General WAGNER. They carry inside it——

Mr. BENNETT. How many men is that, I asked.

General WAGNER. They will be——

Mr. BENNETT. No, the numbers, how many men in the Bradley?

General WAGNER. Nine men.

Mr. BENNETT. Nine men in there, and they each have—or how many of them have antitank weapons that are operating in the Bradley?

General WAGNER. They will dismount normally and can carry up to probably two of the AAWS-M that we talked about earlier.

Mr. BENNETT. They will carry them inside the Bradley as it approaches the front?

General WAGNER. Yes, sir. They can also carry the lighter antiarmor weapons, depending on what they would come up against, if it was BMPs or whatever.

Mr. BENNETT. There is more room in the Bradley than I thought.

## BRADLEY TESTING

General WAGNER. Yes, they carry a lot of other systems in there, too. So, when they dismount, they have them if needed. In that situation, it is not much different, unfortunately, than it was in World War II, you have to go up there and dig them out with infantry.

It is tough. But that is what they are going to do. They will not be assaulting with that Bradley.

Mr. BENNETT. You have given me some reason to be not so concerned about the tactics. How about the testing. What is the procedure? Will you come before this committee to let us know what practical testing you gave the Bradley with respect to improvements you intend to put on, or what improvements are there you intend to put on?

General WAGNER. Obviously, we will come back in the hearings next year, but we would be delighted to come back and brief you on what is going on, what our findings were in those tests, and what we plan to do as a result of those tests.

Mr. BENNETT. Suppose we didn't like them. How would we stop anything? Would we just be informed like the advice and concept in the Senate?

General WAGNER. You approve all the dollars we have.

Mr. BENNETT. Sir?

General WAGNER. You——

Mr. **Bennett**. I am asking between this committee and the R&D—I mean the procurement committee.

General **Wagner**. The procurement committee would be the one to vote on that.

Mr. **Bennett**. That is what I am trying to find out. I am trying to find out whether the R&D subcommittee would ever look at what you purport to do, will we pass on it or not? Just the procurement committee, you say?

General **Wagner**. That would be——

Mr. **Bennett**. I don't know what the staff can tell me. I don't want to take jurisdiction from Mr. Stratton's committee, he is a very able man. That is a very difficult question. If we can make decisions maybe we ought to talk about things we can make decisions on.

Mr. **Darden**. As far as any test and evaluation program would go, I think we would have jurisdiction.

Mr. **Bennett**. I am asking the question, I don't know. I am not answering it. I am just trying to find out. I am also not trying to take jurisdiction away from Mr. Stratton's committee.

I am just concerned since I am concerned about this weapon—the system—if it is going to be changed materially that we don't go ahead and produce a lot of numbers, I understand it is 6,000, the number you expect to procure.

I am concerned that you procure 6,000 and come back to us or not come back at all, but go to another committee. That is all right if it is their jurisdiction. I have nothing further to say about it in that event.

But if it was possible for us to look at it ourselves with jurisdictional right, OK. I am not sure I would like to buy all 6,000 until I look at the new batch. How many do you need ultimately? I guess you have to think a little of how many the Europeans have.

They have something like this, I assume?

General **Wagner**. Yes, sir, they all have a fighting vehicle.

Mr. **Bennett**. It is comparable to this?

General **Wagner**. It is not as good as this. They acknowledge it, the people I have talked to.

Mr. **Bennett**. Not as good in a sense that ours can do more harm to the enemy.

General **Wagner**. Yes, sir.

Mr. **Bennett**. Or not as good, that it is more protective of personnel.

General **Wagner**. Both areas.

Mr. **Bennett**. Both.

Dr. **Sculley**. It is the best in this category in the world. I think Mr. Darden is exactly right on test and evaluation. Quite often, test and evaluation is thought to be completed as you proceed into production, and in fact, it should be thought of as a continuous process where field data, and better technology is fed back into existing production.

So, I would see the prerogatives of this committee on test and evaluation prevailing.

Mr. **Darden**. Dr. Sculley, let me ask you one more question to follow up on what Mr. Bennett is talking about in protecting the Bradley Fighting Vehicle and, of course, the persons inside it.

What about the proposal I understand that is being discussed to put the Hellfire and mount it on the back of the vehicle? Are you formulating some type of launch of the Hellfire from the HMMWV?

### HELLFIRE MOUNTED ON BFV

Dr. SCULLEY. On Hellfire, I feel it is an excellent system. We are in a fortunate position where we have excellent competition between two qualified producers. It has the lethality we need now, and into the future.

I personally see it being of increasing value. I am a proponent and supporter of its wider use beyond the AH-64 and UH-60 to include very serious consideration for ground-launched vehicles.

Mr. DARDEN. It could be used to protect, further protect the Bradley and its occupants.

General WAGNER. If it came in, sir, it would probably be used in lieu of something like the improved TOW vehicle which has no other mission except to shoot missiles. Putting it on the back of the HMMWV, you would have to keep it back out of artillery range because artillery can take it out.

I think it would probably have greater use, for example, in our light forces if you wanted to give them a long-range capability with someone upfront to laser designate for it.

Mr. BENNETT. I have another question, to definitize what I have in mind, I understand you want 6,000 of the Bradley. How many of them will be phase one, and how many will be phase two?

I would be happier if I felt some of the 6,000 would be in phase two, so we would have a chance to look to see how many imperfections have been corrected.

### PHASING OF BFV'S

Dr. SCULLEY. Our fiscal year 1987 procurement request is based on plans to have the survivability fixes included in the production, and they include improvements to the armor and reactive armor.

Mr. BENNETT. How many of the 6,000 you want to get, how many would be improvements?

General WAGNER. It would be about half.

Mr. BENNETT. About half.

General WAGNER. We have had authorized to date approximately 3600-plus, and we still have over 3,000 to go for that 6,800.

Mr. BENNETT. Will we see the testings before you go to the next 3,000 that you referred to?

General WAGNER. I would be delighted to come over and show you the results.

Mr. BENNETT. I guess that is what it is getting down to. I didn't raise objections to what you have, because you feel confident about those. I would like to feel like we could see what was going to be in the improved wings before you bought them.

To buy 3,000 more of them without being very confident about where you are going with them, I think that is what Packard is saying, he says that is one of our problems.

General WAGNER. I would be glad to come back over.

Mr. BENNETT. We get the system rolling and nobody looks at it.

Dr. Sculley. I would emphasize my philosophy on test and evaluation as a continuous process and not something that ends when you enter production.

Mr. Bennett. I understand how you think about it. You are thinking from the executive branch end. I am thinking about the legislative branch. Once we let you run away with it, our constant criticizing of each other is how we save men's lives and save dollars.

What I am afraid of is if you get out of legislative hands into your hands, and industrial complex, and regardless of whether we should make changes or not, we won't stop it. Unless you come back to us before you purchase the new ones.

Dr. Sculley. We are accountable to you and the American people.

Mr. Bennett. OK. So you are going to come back before you purchase the 3,000?

General Wagner. We will come back.

Mr. Bennett. The last 3,000? You will show us tests of the—of what you perfected of the last 3,000 before you actually put the contracts to them? Is that correct?

Dr. Sculley. We would be happy to do that.

General Wagner. We will do that.

Mr. Bennett. Well, we will do that. It would be better than saying you would be happy to do it.

General Wagner. I say we will, sir. As soon as we have the tests and we have a meeting, I will come over and tell you what we are doing. I will do that.

Mr. Bennett. Thank you.

Mr. Battista. Mr. Bennett, you have the gavel again.

Mr. Bennett. OK.

Mr. Battista. Can I ask a question?

Mr. Bennett. Sure.

Mr. Battista. Just so there is no misunderstanding, General, I was not a fan of the MICV in 1977, later on I recommended terminating it. I haven't said anything about it since I was asked to give that statement last month. I will agree that it has got the best cross-country mobility and suspension system of any vehicle I have ever seen or driven. That is not a large number, but that is substantiated by a lot of the users.

The problem I still have with the Bradley is the one I had with the MICV. I have zero mechanized infantry combat experience. So I have to rely on folks like yourself and your predecessors and contemporaries as far as the assessment of the Bradley.

As I go back and you heard a lot of this last month, I remember General Haynes, General Palmer, I remember the Casey Board, bringing dear General Casey, I remember the concerns of Secretary Marty Hoffman, Don Rumsfeld, Kenneth Rush, civilians and military across the board.

The troublesome thing about it is there are a lot of people who feel as though the vehicle was so enhanced that it did a lot of things very poorly instead of the main thing very well and that is support armor.

I referenced a message group sent by General Starry. I hope you have had time to go back and look at that where he said, "Look, if we deploy the Bradley to where it is so effective, the vehicle is not up where it ought to be supporting the armor. If I put the vehicle up where it should be supporting armor, then I have to mal-deploy."

That is the one thing I can remember in General Richardson's letter that indicated concern.

I am wondering at this point in view of the—say in spite of the improvement you will make to it, if it wouldn't be effective to take the two-man turret off some of these vehicles so you could have some percentage of the Bradleys capable of doing what it does best, getting 11 infantry guys up to the line to support the armor.

I remember General Meyer's testimony before the appropriations committee in 1980 where he said if I were doing this vehicle all over again, I would make it carry more infantrymen. I could remember the Fort Carson results that said we need more guys in this thing and to commit three men to it and have only a six-man squad is not the best way to do it.

So you have a vehicle, several thousand more, have you given any consideration in light of these concerns to taking the two-man turret off 500 or 800 or 1,000 and carrying more infantry because everybody seems to agree that it would be nice if we could put more guys in it to do that job.

### BFV BATTLEFIELD EFFECTIVENESS

General **Wagner**. Not everyone agrees. In fact, I talked to General Starry about that recently. I would say that has been looked at many times. When you look at the tradeoffs and effectiveness on the battlefield, we feel that the firepower it gives as a base of fire to the infantry squad makes that squad something it never was in the past, it is a new experience for the infantry.

Incidentally, I am an armor and mech infantryman. That is what I spent my career in. I can tell you that when you fight that squad with the base of fire he now has that he never had before, you have the most effective infantry squad you have ever had.

When you got out of a M-113, you couldn't use the pedestal mounted 50-caliber machine gun to support that squad when dismounted because the probability of killing the squad, if you would give close fire support, was very high.

I have seen people get shot by their own machine guns because you couldn't control the fire.

With this system and the turret you can do that.

Yes, we could take it off. We could carry a few more infantrymen about the battlfield, but they wouldn't be as effective when they got out as they are today with the additional fire power of this sytem.

Mr. **Battista**. Effective in what role?

General **Wagner**. In the infantry role because that is a fire and maneuver element on the ground. You have to have a base of fire. They don't have to carry the machine guns they previously had to carry to lay down a base of fire for the dismounted element. Today you have a six-man maneuver element with a base of fire that is much more effective than the 30-caliber machine guns they used to dismount and set up as a base of fire to protect them. That is how mechanized infantry fights.

Mr. BATTISTA. The only conclusion I can draw then is all that data from the infantry school that said the five-man squad is only 20 percent as effective as an eight-man squad, for the Carson tests, whereafter their evaluation said it has got to carry more guys, the Meyer test which said if I were doing it over again, I would make it carry more infantry guys.

The only thing I can interpret, General, is that all that was just a lot of crank mail.

General WAGNER. If you go back and look at—the first study that said go to the nine-man squad——

Mr. BATTISTA. The first one said 11.

General WAGNER. No. The first study that said a nine-man squad was in 1976.

Mr. BATTISTA. I am talking about the 1964 study which said the best way to go was 11.

General WAGNER. There are many, many studies that tell you what the size of that squad should be. It is dependent on the weapons they are going to carry. It is dependent on what their mission is going to be. I can go out and give you one General, that will say 11 men and another general that would say 9 and we can do that all day long if you wanted. The infantry, if they wanted to could put another soldier in there today because there is an empty seat inside, but they have determined they don't want to do that. They want a nine-man squad.

We could sit here all day and never prove anything.

Mr. BATTISTA. I am going back to General Haynes, General Palmer, General Casey, General Starry, General Richardson, General Meyer, the Fort Carson OPEVAL, and the infantry school study. So that is just not an isolated general saying I would like to carry more. They all agreed on one number—nine.

So be that as it may, let's go to one other subject. This is related to the Bradley, but we were out to Fabrique Nationale and saw their M-249 program. Have you seen the modified weapon they have come up with which in effect will take an M-16 magazine or T-249 with a short stock where the guy could use this thing as a squad weapon and just pull the handle and put a new change on it and get out and have a semiautomatic effective weapon.

I understand the Army basically has terminated in favor of going to a competitive program which it was a competitive program for the 249. Can you update us on that?

The Army escort with us was most impressed, both escorts were most impressed with the whole 249 upgrade program that they had.

General WAGNER. I have not seen that, but I guess you are saying the competitor is also the Fabrique Nationale squad automatic weapon.

Mr. BATTISTA. Yes.

## SQUAD AUTOMATIC WEAPON (SAW)

General WAGNER. That is the weapon that was chosen for several reasons. One, the weight of it, amount of ammunition they can carry, and with the effective range almost doubled the new ammunition we use. The effective range is almost as much as it is for the heavier M-60. That is the weapon chosen as the M-249 squad weapon.

Mr. **Battista.** We didn't get that impression.

General **Wagner.** That it has been chosen?

Mr. **Battista.** Yes.

General **Wagner.** No, it has been chosen. We bought 8,000 of them in fact.

Mr. **Battista.** Would you check with Colonel Matthews to see if that is the same assessment he had gotten because we were told the program has been thrown into a state of limbo right now.

General **Wagner.** Oh, wait. I guess you are talking about the fact that we have now broken production for 1 year.

Mr. **Battista.** Right.

General **Wagner.** Because we wanted to make modifications to it to prevent the possibility of a soldier burning his hand.

Mr. **Battista.** On the barrel.

General **Wagner.** And to correct several other problems.

Mr. **Battista.** Yes.

General **Wagner.** In fact, when I found out about those problems I went out and tested it. I had some rangers come in. They all said buy it, we want it the way it is, but when I saw problems with it I said we shouldn't do that. We've got 8,000, we can give to you if you want one today, but we can fix it. We can fix the barrel cover so it doesn't burn your hand, fix the carrying handle, fix the sights, some of those things to make it a better weapon.

We are doing that now. That is the reason you didn't see any squad automatic weapons in the procurement budget last year, but we will be going into competition for those and continuing production as soon as we make the fixes.

Mr. **Bennett.** I would like the staff to know I have to leave at 4 o'clock so if you want somebody else to preside, you have to get them between now and 4 o'clock.

Mr. **Battista.** That will probably be all right.

Mr. **Bennett.** I have to leave by 4 o'clock. I have a meeting in progress.

What else would you like to go to?

Mr. **Battista.** To the transverse mounted engine for the M1.

Last year you got additional dollars from the Congress. Is that program moving out in proper fashion? We were advised that we were able to do that for $34 million by the contractor and I think the Army program amounted to some $80 million, but that in light of the fact that we have grown the M1 to darn near 66 tons when we get through with it, it would appear we need near-term propulsion upgrades that would give better fuel efficiency and more in the way of performance.

That was a very modest, modest cost.

In conjunction with that, we agreed to go along with the advanced propulsion systems, the AIPS. Are both programs on track so they are not an issue in 1987?

## M1 TANK ENGINE

Dr. SCULLEY. I would guess that it becomes a definition of what is on track. I think certainly there is agreement that we need to look at improved propulsion systems for today's tank in the inventory and for future tanks or for anything that might go into a future family of heavy vehicles.

Our evaluation, however, of the AVCO proposal on the transverse mounted AGT 1500 is that it will not meet the requirements set for AIPS and it has also not been found, nor at this point been determined to be cost effective for retrofit.

Mr. BATTISTA. That was never an issue, Mr. Secretary. We never expected the TME to do what the AIPS would do because the AIPS is the year 2000 and beyond and the TME was not—it was 1989 and beyond to the year 2000.

You got a 66-ton tank with absolutely no propulsion upgrade and TME was designed as an 18- to 24-month program for development evaluation preceded by let's put as many as we can in tanks rolling off the line.

The Army just changed the ground rule and said it doesn't do what it—we never detected it to do what it did last year.

General WAGNER. We have not changed the ground rules. When we looked at the number available for production after we could put it into the inventory, it didn't appear cost effective to change the power pack for the last run or so of the M1 tank.

If you want to modify it in the future and have another version of the M1 tank before you go to some replacement for it in the outyears in the late 1990's perhaps this makes sense. At this time it doesn't make much sense to put it in there.

Mr. BATTISTA. I don't understand. A TME is something you have in 24 months as far as evaluation. AIPS is a paper engine.

General WAGNER. You wouldn't put it into production in 24 months.

Mr. BATTISTA. I am comparing something that is near term that virtually exists, with something that is a concept. I could always conceive of something that would be much better such as, "I am not going to buy a new car this year because it is conceivable they could have a 75-mile per gallon car in 8 years."

That is the analogy. AIPS doesn't exist, or am I wrong?

Dr. SCULLEY. You are not wrong, but we are not exclusively looking long term. We are looking at other alternatives for the 1990–91 timeframe.

Mr. BATTISTA. Which would they be?

Dr. SCULLEY. There is a GM proposal at the present time.

Mr. BATTISTA. That is a diesel?

Dr. SCULLEY. That is correct.

Mr. BATTISTA. But you sold the Congress on the requirement for gas turbines. We know all the reasons why a gas turbine is far better than a diesel. Are we going to take a step backwards?

Dr. SCULLEY. No; we won't take a step backwards, but we will also not just automatically preclude an offer from industry that may have merit that gives us the power that we need, and give us the reliability, availability and maintainability that we need. Since the turbine decision there has clearly been technological advances in turbine engines, but there have been advances in diesels as well. That decision was made some time ago. We have a reliable supplier, the cost has come down considerably, but that doesn't mean we need to close our eyes to other alternatives.

Mr. BATTISTA. Is this a diesel rotary?

Dr. SCULLEY. No.

Mr. BATTISTA. It is a spark ignition diesel or what?

Dr. SCULLEY. I don't know the details, but conceptually it had enough promise to merit further investigation.

Mr. BATTISTA. So it is a much improved conventional diesel then?

Dr. SCULLEY. Those would be your words.

Mr. BATTISTA. No; I am asking. I am just asking what the Army—what criteria the Army uses for saying now we have this. You said improved diesel. I am just wondering specifically what improvements were made to make it competitive with the gas turbine. You know Mr. Stratton had a problem back in 1976, it was a very contentious issue. The Army was solid, they put up a solid front that we need the gas turbine, it is much better.

In fact, let's face it, the announcement that GM had been selected as the winner of that competition was up here when the colonel in liaison was told to pick them all up and that was a diesel engine. That was the reason we wanted you to put a turbine engine in and now we got that, and you are telling us we are going back to the diesel engine.

### M1 ENGINE PRODUCTION

Dr. SCULLEY. I have been around long enough I guess to preside over production of over some 3,000 of these engines which again have proved to be a good engine. I am not critical. Certainly it has improved with production, but again I just emphasize that will not close my mind to any alternatives in the future that merit investigation. I think it would be unfair just to constrain any consideration to a tranverse mounted version of what we have and I think you would agree.

Mr. BATTISTA. Well, OK, then I would also agree that as long as we have this diesel on the drawing board then I can use the same criteria you say exists in the budget constraint environment and say we shouldn't do the AIPS either.

Dr. SCULLEY. Again I think we need to look at what is the purpose of AIPS.

Mr. BATTISTA. That is a technology in only one of those fields.

Dr. SCULLEY. The objectives would have the under armor volume and still reduce fuel consumption and decrease life cycle costs by a factor of 3. If that is not a prudent investment of RD, then I would accept that.

General WAGNER. AIPS is both technologies, turbine and diesel technology for the future.

Mr. BENNETT. I hate to say this, but I have difficulty again with the various elevators and things I have to go through, so I don't think I can come back.

Mr. BATTISTA. I think probably we have to adjourn then.

Mr. BENNETT. Unless you get somebody else to come.

I just can barely make it now. My friend is about to take me so, I am sorry I have to go.

Mr BATTISTA. Can I recommend that you have Dr. Sculley and General Wagner insert the balance of their presentation for the record. [See page 831 (March 5, 1986 hearing date).]

Mr. BENNETT. Without objection, that will be done.

Mr. BATTISTA. Thank you.

Mr. BENNETT. I look forward to those test results now.

General WAGNER. Yes, sir. I will personally come over and brief you.

[Whereupon, at 3:40 p.m., the subcommittee adjourned.]

# STRATEGIC DEFENSE INITIATIVE AND ANTISATELLITE PROGRAMS

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House of Representatives,
Committee on Armed Services,
Research and Development Subcommittee,
*Washington, DC, Tuesday, March 11, 1986.*

The subcommittee met, pursuant to call, at 10 a.m., in room 2118, Rayburn House Office Building, Hon. Melvin E. Price (chairman of the subcommittee) presiding.

Mr. Price. The subcommittee will be in order.

At the request of the House Armed Services Committee, the Office of Technology Assessment undertook the task to assess the opportunities and risks involved in an accelerated program of research on new ballistic missile defense technologies. The study was completed last fall and will be the subject of the hearing today.

The witnesses will be Dr. Thomas H. Karas, project director in the Office of Technology Assessment and Dr. Peter Sharfman, Office of Technology Assessment Program manager for International Security and Commerce.

Dr. Karas, you may begin.

## STATEMENT OF THOMAS H. KARAS, PROJECT DIRECTOR, OFFICE OF TECHNOLOGY ASSESSMENT

Mr. Karas. Thank you, Mr. Chairman.

We appreciate the opportunity to brief your subcommittee on our two recently released reports, "Ballistic Missile Defense Technologies" and "Anti-Satellite Weapons, Countermeasures, and Arms Control". Together, these two reports run to several hundred pages, so we cannot relate all our findings to you this morning.

My prepared statement will focus on two major issues which we believe may be of particular interest to your members. The first main topic would be BMD research program options and the second, potential Soviet reactions to U.S. BMD deployments.

We stand ready in the question period not only to address these issues in more detail, but also to take up other subjects of interest to the subcommittee.

The first page of our handout lists topics analyzed in our reports which may also be of interest to you.

Also attached are the tables of contents of these reports.

With your permission, Mr. Chairman, we will submit for the record the summaries of the reports.

Mr. Price. Without objection, it will be included in full in the record.

[The above-mentioned material is retained in subcommittee files.]

Mr. KARAS. Thank you.

I have with me at the table Dr. Peter Sharfman, OTA program manager for International Security and Commerce, who supervised our project.

Accompanying us is most of the project staff—Michael Callaham, Richard DalBello, Gerald Epstein, Anthony Fainberg, and Alan Shaw.

With your permission I will ask them to answer those questions later which are relevant to the parts of our reports they each worked on most intensively.

Almost everybody concerned with the Strategic Defense Initiative can agree that research into technologies that could be applied to ballistic missile defense is necessary.

But there is less agreement in the country about the emphasis, direction, and level of effort our research program should have.

To help clarify the choices the Congress faces on this question, we have identified three broad approaches to ballistic missile defense, or BMD research.

We also describe two variations on each of two of those approaches. That adds up to five variations of one kind or another.

The current baseline approach to BMD research is, of course, the Strategic Defense Initiative Program as proposed by the administration.

The purpose of this program is to investigate advanced BMD technologies vigorously enough to permit a decision in the early 1990's on whether to enter full development and deployment of ballistic missile defense systems.

An assumption of this program is that BMD technology now within the state of the art does not warrant immediate deployment.

But the program is also based on the belief that the potential of advanced BMD technologies is such that a technology-limited effort, rather than one limited by funding constraints, is very likely to lead to defensive systems that could improve our national security.

There are those who believe that a worthwhile ballistic missile defense system could be deployed much earlier than originally implied by the SDI Program. We found two major variations on this idea of earlier deployment.

First, earliest deployment: Some place a high strategic value on the relatively modest levels of ballistic missile defense capability that we could obtain using currently available, off-the-shelf technologies.

Under this approach, while we would continue work on more advanced technologies, our R&D Program would emphasize full-scale engineering development and early deployment of the defenses we could build in the next few years.

Intermediate deployment: Others advocate that our research emphasize technologies advanced beyond those that we could deploy in the very near term, but which might nevertheless be ready for deployment in the early 1990's.

This approach, too, would seek to assure that investigations of some of the longer term SDI technologies would continue but not delay earlier deployments.

Indefinite deployment: Other approaches do not imply a definite time of decision for BMD deployment.

Funding-limited approach: One of these alternatives would be to investigate the same advanced technologies as the SDI, but at a lower funding level and with a much-reduced sense of urgency.

Such an approach would delay for an uncertain time our ability to make a decision on whether the highly capable defenses being pursued under the SDI would be feasible and desirable.

Under this approach, it would be prudent to avoid tests or demonstrations which might raise questions of compliance with the ABM Treaty, since we would be trying to sustain the treaty regime for an indefinite period.

Combination approach: Yet another approach to BMD research would try to balance research in advanced BMD technologies with the development of near-term deployment options which would include traditional BMD technologies, such as nuclear-armed, radar-guided interceptors. This was pointed out by Harold Brown in his recent article in "Foreign Affairs."

This program, with funding levels considerably below those requested under SDI, would not aim at a specific BMD deployment decision. Instead, its main purposes would be to deter Soviet abandonment of the ABM Treaty, to prevent technological surprise, and to investigate the long-term potential of advanced BMD technologies.

In the OTA report, we discuss some of the implications of each of these approaches to BMD research. In particular, we examined some of the issues that Congress might want to consider as it deliberates over the emphasis, direction and funding of that research.

These issues include the following:

First, the relationship between our BMD research and the ABM Treaty: Does our research program imply abandonment, temporary continuation, or long-term strengthening of the ABM Treaty?

We call attention to the desirability of not inducing the Soviets to withdraw from the Treaty at a time more advantageous to them than to us.

This could prove a very delicate task if we are, on the one hand, stating our desire to preserve the Treaty in the short term, but, on the other hand, stating our intention to depart from the treaty regime if and as soon as our research proves successful.

Another issue is the relationship between our BMD research and other arms control measures. To what degree does the research program either hinder or stimulate progress in arms control negotiations?

Movement toward the negotiated transition to a defense-dominated world of which Administration officials have spoken would be a very difficult and complex task.

We believe that a much better case for how this can be done needs to be made than has been made so far.

A third issue would be the connections between antisatellite weapons and antisatellite weapons arms control and BMD. Can and should our BMD research be conducted in a way that would be compatible with arms control measures restraining the testing or deployment of advanced anti-satellite weapons?

We must face the fact that we must choose between unconstrained BMD research on the one hand and the potential supplementary protection that ASAT arms control might offer to our military uses of space on the other.

In either case, unilateral measures to protect U.S. military satellites of all types will become increasingly important in the next decade.

Fourth, the timing of the decision to move from BMD research to BMD deployment. At what point would our research program virtually commit us to a decision to deploy ballistic missile defenses? How prepared are we to deal with the Soviets' deciding to deploy before we do?

The risk we face here is that we might essentially be forced to proceed with BMD deployments even if our research does not prove them to be cost effective and strategically stabilizing.

The fifth issue revolves around the implications of the technology demonstration experiments to be conducted as part of our BMD research program. Will such experiments be compatible with our arms control policies?

Specifically: It may be prudent to avoid threatening the viability of the ABM Treaty before we are certain that it is in our interests to abandon the treaty regime.

The Congress may wish at a minimum to assure that demonstration experiments are associated with BMD systems designs [architectures] that are genuine candidates for deployment.

We will also want to try to avoid investments in demonstrations that tend to lock us in to less than optimal BMD technologies.

The sixth issue is the relationships between research on strategic defenses and strategic offensive weapons and countermeasures. This and other Congressional Committees may wish to assure themselves that our research is adequately preparing us to respond in a timely way to potential Soviet BMD deployments and to anticipate Soviet offensive responses to the defenses we are developing.

That is a fairly brief summary of those issues which we would be glad to return to in the questioning period, but we will turn to the other major topic that we thought might be of interest to the committee, and that is the potential Soviet reactions to projected or actual U.S. deployments.

As we conduct our research program on ballistic missile defense technologies, we can expect the Soviet Union to continue its own BMD research.

In addition, we can expect the Soviets to try to hedge against our eventual BMD deployments by doing the research necessary to prepare their own offensive, as well as defensive, responses.

In general, OTA concurs with the original Fletcher Commission assessment that the ultimate degree of effectiveness of a United Staters BMD system will depend on the Soviet responses to it.

I will indicate what we see as the range of potential Soviet responses to eventual United States BMD deployments. We need to consider those responses, whether our own BMD deployments are made either independently of or because of a future Soviet BMD deployment.

The range of Soviet reactions we believe should be considered includes the following:

One, Soviet BMD deployments.

Two, agreement to negotiate offensive force reductions—inducing the Soviets to follow this course has been stated as a goal of the SDI.

Three, tacit stabilization of offensive force levels.

Four, increases in the numbers of ballistic missiles or reentry vehicles.

Five, development and deployment of passive or active countermeasures intended to reduce the effectiveness of our defensive weapons.

Six, deployment of new or additional strategic nuclear delivery vehicles—such as low-flying cruise missiles—not vulnerable to attach by BMD systems.

Seven, deployment of defense suppression weapons intended to attack components of our BMD systems, particularly those based in space.

I should point out that this list is limited to development and deployment options. Here I will not address the degree to which certain configurations of forces on the two sides might increase Soviet incentives to strike first in a crisis. This issue is discussed in our report, however.

Now, I will say just a few words about each of those possibilities I just listed.

One, Soviet BMD deployments. We, of course, cannot neglect the possibility that the Soviet Union will decide, in its own time, to deploy a BMD system, whether we decide to do so or not.

The Defense Department Publication, "Soviet Military Power, 1985", suggested that . . . the USSR may be preparing an ABM defense of its national territory.

The intelligence community, however, has not predicted that the Soviets will do so.

In the absence of a United States-Soviet agreement to coordinate defensive deployments, a Soviet BMD deployment would, as the Secretary of Defense has stated, call for an intensive United States program of offensive countermeasures.

It would also call for a U.S. decision on the timing of our own BMD program that might involve our trading off quickness of early deployment against effectiveness.

Whether or not we believe there is a high probability of the Soviet initiation of nationwide BMD deployment, we certainly need contingency plans for dealing with the possibility of a Soviet breakout from the ABM Treaty.

At the same time, we should be aware that our own actions may influence the Soviet deployment decision.

At least in the near term, the Soviet Union is better prepared than the United States to deploy a nationwide, if only modestly effective, BMD system.

If and as we move toward our own BMD deployments, we need to consider the implications of this asymmetry—in particular, the potential strategic disadvantages it could pose for the United States.

A second Soviet response might be, as I mentioned, agreement to negotiate defensive deployments along with offensive force reductions.

Administration officials have repeatedly emphasized the importance of cost effectiveness at the margin for U.S. BMD deployments.

This means that additional increments of defense should be markedly less expensive than corresponding increments of offense or offense countermeasures.

In short, the Soviets should see that they would lose an arms race between the United States BMD deployments and Soviet offensive missiles and countermeasures.

Logically, one result of this situation would be that the Soviets should accept the obsolescence of their ballistic missiles and agree to a phasing out of such weapons and a building up of defenses on both sides.

Nevertheless, we believe the potential for this negotiated transition is subject to many uncertainties, and much more work needs to be done to make a credible case that it can be achieved.

We should also recognize that even a favorable cost-exchange ratio between defense and offense does not assure an immediately favorable outcome.

Should we proceed without a negotiated transition, the ensuing arms race could become quite expensive—and possible destabilizing—before the Soviets finally realized and accepted its futility.

Three, tacit stabilization of offensive force levels. It is possible to imagine that the Soviets will tacitly, rather than formally, admit that the declining military utility of ballistic missiles makes them dispensable.

In this scenario, the United States and the Soviet Union simultaneously—but without formal agreement—might build strategic defenses while limiting or reducing their offensive arsenals.

But because of the many asymmetries between Soviet and United States force structures, we believe this a highly improbable outcome.

Four, increases in the numbers of ballistic missiles or re-entry vehicles. One way of looking at less-than-absolutely-perfect defenses is that they can raise the price of attack—that is, require the enemy to launch more weapons to hit the same number of targets.

It is important to note that the ultimate utility of this offensive response, and of the other offensive responses I am discussing here, depends again on their cost-exchange ratio with the opposing BMD system.

If the price we are willing to pay to stop one Soviet nuclear warhead is greater than the price they are willing to pay to get another one through, then our defenses will dominate the arms competition. The price, however, may be high, and it might grow very high.

A different response could be the development of passive countermeasures intended to reduce the effectiveness of our defensive weapons.

Depending on the types of BMD systems we might deploy, there are various ways the Soviets could make their missiles and warheads harder to find, harder to track and aim weapons at, or harder to destroy when hit.

Some of these measures might involve substantial reconfiguration of Soviet missiles, while others might involve relatively small changes.

All, of course, will depend on exactly the kinds of defensive systems the Soviets expect us to deploy or see us deploy.

Unless and until the two sides agree to limit offensive forces, the competition in countermeasures and counter-countermeasures could continue for some time without clear resolution in favor of the offense or the defense.

A sixth response could be deployment of new or additional strategic nuclear delivery vehicles, such as low-flying cruise missiles, not vulnerable to attack by BMD systems.

If the goal of our strategic defenses is only to complicate and make uncertain the prompt, hard-target kill capabilities that the Soviets appear to prize in their ballistic missiles, then we need not necessarily deal with Soviet air breathers.

But if our goal is to, "make nuclear weapons impotent and obsolete," then defense against numerous, possibly very accurate, cruise missiles also becomes essential.

A seventh type of response might be deployment of defense suppression weapons intended to attack components of our BMD systems, particularly those based in space.

In the final 1986 appropriations continuing resolution, the Congress has instructed OTA to examine the potential survivability of defense systems being studied under the SDI.

It is clear to us and to the SDIO, that survivability will be a key criterion for any ballistic missile defense system.

We are particularly concerned about the potential threats to space systems—a subject examined in the companion report to our BMD report. I should point out, however, that this is a difficult topic to deal with in unclassified session.

Thank you very much. We would be happy to respond to your other questions, Mr. Chairman.

Mr. PRICE. What are the differences in the technology required for ballistic missiles and the antisatellite systems?

Mr. KARAS. One of our staff members, Michael Callaham, looked into these technologies in some detail, and particularly at satellite technologies.

I wonder if he could spend a couple of minutes responding to that.

Mr. CALLAHAM. At first glance, many of the generic types of technologies for weapons—we must remember, they require surveillance and control systems, as well—would appear to be applicable to either case.

For example kinetic energy weapons, neutral particle beam weapons, laser weapons of various types, and high-power radiofrequency weapons—these major categories, and some others, could be used in weapons either for antisatellite or ballistic missile defense purposes.

One type of laser weapon discussed in our reports would be a ground-based laser reflecting off of orbital mirrors.

A system of that sort could be used with varying degrees of effectiveness either for ballistic missile defense or for antisatellite purposes.

In some cases, however, if one wanted to use a technology for both ballistic missile defense and antisatellite use, one would want to build different types of weapon for each application. The reason for this is that in many cases, the timelines and enemy countermeasures would be very different.

For example, in the context of ballistic missile defense, the problem is to rapidly detect, identify, and recognize, perhaps many tens of thousands of re-entry vehicles among a larger number, perhaps, of penetration aids, and to destroy them very quickly.

The antisatellite case is much more complicated, because you can imagine forms of antisatellite conflict at various levels of intensity, ranging from peacetime crisis to nuclear war.

In some of these antisatellite cases, you might be able to observe satellites and try to discriminate them from things that wouldn't be targets, over a very prolonged period and without a great deal of overt interference, particularly without the interference of nuclear weapons or effects.

By comparison, in ballistic missile defense cases, one has to contend with inadvertent or perhaps deliberate nuclear interference and find and destroy targets much more quickly.

The point there is that the same technologies could be used in general, but in some cases, you would want to build different types of weapons with them.

Mr. **Sharfman**. There would be thousands of RV's possibly hidden among tens of thousands of decoys or other space objects.

Mr. **Price**. Since we have an ABM Treaty but no antisatellite treaty, how would we handle an antisatellite deployment since the technology for ABM is not very different?

Mr. **Callaham**. With no restraints on antisatellite deployment other than those that currently exist, how would we handle a Soviet deployment in the sense of our options?

Mr. **Price**. How would we handle our own deployment?

Mr. **Callaham**. Could we deploy antisatellite weapons?

Mr. **Price**. Yes.

Mr. **Callaham**. The existing international regime does not prohibit deployment of antisatellite weapons, as such.

There are, however, several treaties including the ABM Treaty that restrict the types of weapons that could be deployed.

The ABM Treaty prohibits the deployment of weapons in space, and, it is a little bit vague, weapons to counter strategic ballistic missiles or their components in flight.

The wording of the treaty is not specific as to whether that is an intent or capability. In addition, it is prohibited by the Outer Space Treaty to deploy in space any weapon which contains a nuclear explosive.

One can imagine ways in which we could deploy nonnuclear weapons, for example a space mine, in synchronous orbit, that could not destroy ballistic missiles. Deployment of such a weapon would be permitted but there is some ambiguity in other cases.

If one wanted to deploy a system of orbital relay mirrors, the capability of that, especially if there were very many mirrors, would be ambiguous, and might have some BMD capability, perhaps considerable BMD capability.

It might well be interpreted as a violation of the ABM Treaty.

If you want a detailed discussion of that, I refer you to Mr. DalBello, here.

Mr. DALBELLO. Just one point in answer to that question. The ABM Treaty would not prohibit the deployment of an ASAT system except insofar as it violates article 6.

To the extent that you could prove an ASAT weapon had BMD capability, it would be arguably prohibited by the ABM Treaty.

Mr. SHARFMAN. However, since for the reasons Mr. Callaham has stated, it is easier to attack a satellite given lots of time than to attack a larger force of ICBM's in a very short time, it would presumably be possible to develop and deploy an antisatellite system capable against satellites, but with very low capability against ICBM's.

Mr. PRICE. Mr. Dickinson.

Mr. DICKINSON. Let me talk about ASAT's just a minute.

Are you prepared to talk about that as well as ABM?

We have had two ASAT tests, right? The Soviets have had from 17 to 18 that we know of. We have an ongoing fight in the Congress as to whether or not we should eliminate or prohibit a further ASAT test.

I think the Air Force only plans two more, and correct me on that. Is that right?

Mr. CALLAHAM. I am not sure I can speak to the Air Force plans at this point for the future testing schedule.

Mr. DICKINSON. Do you know how many might be required?

Mr. CALLAHAM. That information, the number of tests required, would be classified, and I don't have that with me now. We could get that.

Mr. PRICE. For the record.

Mr. DICKINSON. You can forget it, as far as I am concerned. I will ask the Air Force.

We fought, bled, and died to get an ASAT capability and permit it, and got two approved in the last conference with the Senate.

Within the time allowed, the Air Force wasn't able to get off but one test. My recollection is, they felt like they only needed one or two more. You say you can't speak to that in open session.

Mr. CALLAHAM. I can't quote specific numbers.

I could say there were different kinds of tests involved.

Mr. DICKINSON. I am talking about specifically the missile that they are going to put on the bottom of the F-15 that will go up and make an intercept of an object in space.

Mr. CALLAHAM. Yes, there would be different kinds of tests planned for that, some against instrumented target vehicles and different levels of readiness which the Air Force would consider that it had attained after given numbers of tests, but the exact numbers are classified.

Mr. DICKINSON. I don't have any more questions, Mr. Chairman.

Mr. PRICE. Mr. Bennett.

Mr. BENNETT. I certainly appreciate your testimony today.

I am sort of like Mr. Dickinson. I have a lot of questions in my mind which you have not resolved, which nobody expects you to resolve.

We are not trying to make a facade of clarity when we actually have a very difficult situation.

I was the author of the legislation which was passed in the last Congress, of the questions raised, and you have addressed some of those, in section 222, having to do with what the response of the opponents might be.

And from what you said today and what I read before, it would seem to me that one great project suggesting SDI to the world might be that we all agreed not to have it and we also agreed at the same time to cut out on some of our offensive weapons.

When you get into the idea of having it, then you immediately have the problem that you raise among others, that there might be a cheap answer to it without them even developing an SDI.

They could just mount for offensive weapons. You have not dealt with the percentage of weapons that could be expected to be stopped. I don't know if you ever came up with a figure like that or not.

The figure I have heard is at least 90 percent could be knocked down, but 10 percent probably could not, and since they have 10,000 rounds, that would leave them 1,000 rounds about the size of Hiroshima and Nagasaki. That is not very reassuring.

My hometown, Jacksonville, FL, is the 22d largest city in the United States, and many people in this room probably never heard of Jacksonville, so when you think about that, and think about 1,000 rounds, any one of which could knock out Jacksonville and several other metropolitan areas, that gives grave concern.

So I am wondering in the studies that you have made, have you come up with anything that would indicate to you that we could conceivably have a verifiable treaty to stop this sort of thing on both sides?

I have a feeling that in my lifetime two tremendous defense things have happened.

One is the atomic weapon, and the other one is this twisted idea of having an umbrella over all the United States, all of Russia. That is what essentially this is. It is the ABM Treaty nullified.

This seems to me to be a new plateau of horrendous proportion and very devastating to humankind. If you could uninvent the atomic weapon, I would like to do it.

I wonder why we are on a course to invent something else which might be equally horrible. Is there some way in your studies that you feel like a verifiable treaty could be established to protect against either side having that?

Mr. KARAS. Mr. Bennett, we certainly raised the possibility of attempting to continue. We have now an ABM Treaty regime intended to do what you are saying.

Mr. BENNETT. By its very terms it says you can't protect the whole nation.

Mr. KARAS. There are various ways in which people are concerned about the potential erosion of that treaty, both in terms of Soviet violations and in terms of the ways in which technologies may develop in ways unforeseen by the treaty, such that the other side might come much closer to a deployment breakout capability than was intended by the treaty.

We did not address the conditions and probabilities of future ABM treaty regimes.

I guess I would observe that nationwide ABM systems will be large scale. There will be many visible components, and it would seem on the technical side, as opposed to the political one, which I won't comment on, that there would be some opportunities for verification there.

Mr. EPSTEIN. We don't say whether a treaty could or could not be verified. Some things are easier to do than others. Laboratory research has been generally acknowledged to be impossible to verify on the other side.

We also note that some of the demonstrations which are necessary in order to go from laboratory research toward a deployed system are bigger and more visible than laboratory research, so we point out that some of the demonstrations may be easier to include in a treaty, although we don't make the judgment you could or couldn't.

We just say there is a scale.

Mr. BENNETT. The possibility of turning it into an offensive structure, not just a defensive structure, in your studies have you come to any conclusion about the possibility of that occurring on either side?

In other words, is it something that is so visible that you would be able to verify that aspect of it?

In other words, nobody really wants to go, in America, toward an offensive system in space that I know of, including the President.

He doesn't want that. The question is, when you know that you can develop a weapon very reasonably easy because of other research you have made, there are not many instances in history that I can think of, in fact none, where people have not proceeded to the offensive type of a weapon.

Is there some way that that aspect of SDI can be controlled? That is, the transition to offensive weaponry?

Mr. SHARFMAN. We did not address that question specifically in our report or in our research.

We can say a couple of relevant things. In the first place, the distinction between offense and defense is often more a question of why a weapon is being used than it is a question of the specific weapon involved.

For example, to take an extreme example, if one side but only one side had an effective ballistic missile defense, then that side might feel that it had become relatively safe to launch a first strike, because the effective defense could protect against a second strike. You would then have a defensive system which had the effect of increasing the offensive capabilities of the possessor of the defensive system.

Going beyond that, one can say that if defensive systems deployed in space became very large, then this would create a sort of an infrastructure that could eventually be the basis for developing offensive weapons based in space.

However, to our knowledge, there are no such offensive weapons presently in development, and it would be many a long year before one would move from defensive weapons in space to any other kinds of weapons in space.

Mr. KARAS. I would add that one subject we did touch on is that defense suppression can be a form of offense if you can preserve your own defenses while attacking the other side's defense. One issue which we think will be addressed increasingly in the future is the ways in which BMD systems deployed by both sides might have the potential for attacking one another.

If we both had large-scale weapons systems based in space that were capable not only of attacking reentry vehicles but of attacking other satellites, that is potentially a very destabilizing situation, and we hope that ways will be found to avoid a mutual vulnerability of defensive systems that way.

Mr. **Bennett**. You addressed one of the things raised in this statutory matter which has to do with the utilization of cruise missiles and things like that.

You indicated that would have to be dealt with, too, because there would be a growth in that area if you just took care of the ballistic missiles, but there are two other things that I am not sure that you dealt with in detail.

The main one is the degree of the dependency of success for SDI upon a potential enemy's antisatellite weapon's capability.

What I am getting at here is, does the SDI depend upon a treaty against attack upon satellites?

Mr. **Karas**. That would depend to a high degree on the kind of architecture which the SDIO chooses. They have stated as a criterion for any BMD deployments that they will be survivable, so that implies that they intend to find ways to avoid elimination or unacceptably reduced effectiveness of their space-based BMD systems from enemy ASAT attacks.

Mr. **Bennett**. By the definition of what is being sought, you don't have to worry about it?

Mr. **Karas**. They certainly must worry about it, and indeed, we have to assume that it will be a highly determinant factor in their choice of BMD architecture.

Mr. **Bennett**. That would make it unnecessary, then.

Mr. **Karas**. They would have to try to build an architecture that avoided that vulnerability. That is going to be tough.

Everybody recognizes that as one of their key problems and General Abrahamson has identified that as a key issue.

There are various techniques by which you can hope to defend space-based assets from antisatellite capabilities.

Peter.

Mr. **Sharfman**. I would recall also the point made in answer to the Chairman's initial question.

A deployed space-based ballistic missile defense system would have an inherently great capability against satellites.

If you can shoot down a missile in flight through space, you can shoot down a satellite in flight through space, so it is difficult to conceive of a combination of, on the one hand, a deployed ballistic missile defense system with space-based components, and on the other, a treaty banning antisatellite weapons or otherwise protecting satellites.

Mr. **Bennett**. If you could protect the satellites, you could probably protect the weapons coming in, couldn't you?

Which is more difficult to hit? I would think satellites would be easier to knock down.

Mr. Fainberg. That is a somewhat complicated question. The answer depends on the scenario, on the architecture of the ballistic missile defense systems and on the nature of the satellites.

People who argue in favor of the likelihood of making a survivable system will argue that you can provide through shielding, and through redundancy or other means, methods of making the satellite part of your BMD system survivable. However, any judgement as to whether a system is survivable requires, first of all, an architecture to be fairly well-defined, and also requires a knowledge of what defense suppression mechanisms and antisatellite systems the adversary might use.

It is far too early now to predict who would win in such a case. In principle, it is easier to shoot down a satellite, because their orbits are much more predictable and you have much more time to do it than to shoot down ballistic missiles.

However, the satellites can be shielded and other means can be taken to protect them, and it requires a good deal of thought and study and more data than we have at the present time to determine whether satellites or ballistic missiles would be more survivable in practice.

Anybody who says he has an answer right now is not serious.

Mr. Bennett. Well, we do have some experiences in life, and as a former infantry soldier, if I had landed every weapon that I put into the direction of an enemy in World War II, MacArthur and I would be sharing the honors for winning in the Pacific.

What I am saying here is, you shoot many rounds and don't hit the enemy, and I just can't conceive, myself, of a program which won't have a certain, fairly substantial number of rounds getting through.

It is very difficult for me to understand how there could be a prophylactic situation which none could get through, so there has to be some kind of percentage, and arriving at that percentage is an important thing in evaluating this, because whatever it may be, it would seem to me to be much, much cheaper for the other side to produce greater capability of effective offensive weapons.

It seems to me that would be much cheaper than creating another SDI, although all they have to do is wait about 10 years and get our SDI, because history shows you can't keep it secret.

We are on our way to having both nations, where we both have the same essential ability to have a SDI.

It has never been different in history, so I see no reason to think it will be different on this.

The immediate problem, the immediate answer would be to increase the number of ICBM's which could readily be done much cheaper than creating another SDI.

Mr. Fainberg. One possibility is proliferate warheads, and the Soviet SS-18 can carry far more warheads.

There are all kinds of penetration aids which may be far more cost effective, in fact, than proliferating warheads. Those have to be considered as well.

Mr. [illegible]. There is general agreement that the earlier we get [illegible] deployments on either side the more [illegible] it is that the [illegible], it is a combination of proliferation of [illegible], and penetration aids.

In testimony last summer, CIA officials predicted that by 1995 the Soviets will have rolled over almost their entire strategic missile force. In other words, they will have an entirely new set of missiles by then. This offers opportunities for countermeasures.

But let us also remember that the long-term objective of the SDI is to change this equation which you have just talked about and which has been the common sense thus far. In other words, their central objective is to reverse what is cheaper to do and they believe that they can make the defense cheaper than the offense.

Mr. [illegible]. Any reason to think that you can make the defense cheaper than the offense?

Mr. [illegible]. It is an explicit objective of the SDI program to invent a defense that is cheaper than the offense in the sense we have just discussed it.

Paul Nitze has stated with the approval of the White House that they wouldn't wish to deploy a defensive system unless it was cost effective at the margin. This means that if the Russians try to overwhelm our defenses, it would be cheaper for us to overcome that than it would be to overwhelm it.

The research is a long way from being completed and it remains to be seen whether, in fact, it will be possible to reach that objective or not.

The SDI as a research program aims in large part to answer that question.

Mr. Price. Mr. Courter.

Mr. Courter. Just one preliminary comment.

I find it always very interesting when I hear the argument about proliferation of warheads as a counter to strategic defense.

That argument is never raised with respect to other attempts to create this survivability in your deterrence.

If someone argued that proliferation would be the result of a deployed SDI, one could likewise argue that proliferation is a possible outcome of the deployment of Midgetman, and the purpose is to increase survivability, and the way you get around that, possibly, is proliferation.

But it seems to me it is always brought up with respect to SDI and never with respect to other methods of attempting to make your deterrent more survivable, by hardening or stealth or mobility.

I just would like to say that the report of the Office of Technology Assessment is—I read it—and in my mind it is not exactly bullish on strategic defense. That may not have been your desire, but that is the opinion that I get from reading it.

It is not universally accepted. The OTA report is extremely controversial and there are very many eminent scientists who take exception to the conclusions that you have.

In that regard, I am sorry that, as part of the hearing today, we did not have the opportunity to hear from people who take issue with the conclusions of your report, and being that as it is, however, what I would like to do is ask unanimous consent that the report by Dr. Seitz and Dr. Robert Jastrow, "Ballistic Missile Defense Technologies: A critical commentary on the OTA report," be included in the record.

Mr. Price. Without objection.

[The following information was received for the record:]

# "Ballistic Missile Defense Technologies"

# (Office of Technology Assessment, 1985):

## A Critical Commentary

## on the OTA Report

by

Dr. Fred Seitz and
Dr. Robert Jastrow

October 1985

Dr. Frederick Seitz, a member of the SDI Scientific Advisory Panel, is a past President of the National Academy of Sciences and American Physical Society, and President Emeritus of Rockefeller University. He is also former Chairman of the Defense Science Board. In 1973, he received the National Medal of Science, America's highest award for scientific achievement, for his contributions "to the foundation of the modern quantum theory of the solid state of matter." In 1983, he received the Vannevar Bush Award, presented by the National Science Board of the National Science Foundation. He is a Consulting Editor in solid-state physics for the Encyclopedia of Science and Technology.

Dr. Robert Jastrow is Professor of Earth Sciences at Dartmouth College. In 1961, Dr. Jastrow founded NASA's Goddard Institute for Space Studies, serving as its director until 1981. He also served as first chairman of NASA's Lunar Exploration Committee. His books include Astronomy: Fundamentals and Frontiers. He is considered one of the world's leading experts on strategic defense and has written How to Make Nuclear Weapons Obsolete (1985, Little, Brown & Co.).

Seitz and Jastrow are members of the Board of the George C. Marshall Institute in New York, which sponsored the study of the OTA Report.

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## Commentary on the OTA Report
## BALLISTIC MISSILE DEFENSE TECHNOLOGIES

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[illegible] appears [illegible] nexpectedly rapid progress, almost across the board in the SDI program, had led General Abrahamson to announce recently in Congressional testimony that it may be possible to cut more than a decade from the timelines laid out by the Fletcher team. That would mean key demonstrations before the end of this decade and possibly deployment in the 1990s.

This sense of rapid movement on numerous technical fronts in ballistic missile defense is missing from the OTA report. The report preserves the negative tone of its predecessor, the report to the OTA by Dr. Ashton Carter, in its judgments on the technical merits of the new technologies. We suggest that this negative view of the concrete technical accomplishments in ballistic missile defense in the last year betrays a biased attitude toward strategic defense on the part of the report's authors. Among major accomplishments that receive little or no attention in the OTA report are the following:

The Free Electron Laser. This is a dark horse among laser technologies that has come to the fore in the last year as a result of exceptional progress at Livermore and Los Alamos. Livermore scientists have tested a free electron laser at a peak power of one billion watts with peak powers of a trillion watts in prospect in a few years, as well as repetition rates of thousand of pulses a second. Prospects appear to be excellent for achieving average power levels far greater than the 20-million-watt level deemed necessary for an effective laser defense against Soviet missiles. Rapid progress has also been made toward multimegawatt power levels in the other types of lasers. The MIRACL laser at White Sands has been tested at a power level of several million watts and work is now in progress on mating the MIRACL laser to other components needed for a full weapons system.

The Rubber Mirror. When the President gave his speech laser technologies already offered promise of a defense against missiles. However, it was not clear whether to keep the laser on the ground or put it into a satellite orbiting over the Soviet Union. Putting the laser into a satellite seems like the most direct method but has the disadvantage that the heavy weight of the laser plus its fuel and power supplies have to be lifted into orbit. Keeping the laser on the ground solves that problem but has the drawback that the atmosphere tends to spread out a laser beam, so that it cannot be focused to a sufficiently sharp and intense spot to destroy the missile.

Last month a critical test was run with a device called a "rubber mirror", which changes its shape many times a second in such a way as to correct for the spreading effect of the earth's atmosphere. This test seems to settle the question in favor of keeping the lasers on the ground.

In the test, a beam produced by a laser on the ground was bounced off a "rubber mirror" and then reflected upward to space, where it accurately tracked a rocket moving at very high speed. The "rubber mirror" kept the beam tightly focused on the rocket in a highly successful demonstration of the method. This test is a milestone in SDI progress because it opens the way to the use of ground-based lasers in missile defense.

As General Abrahamson indicated, that means laser defenses may become a reality ten years earlier than anticipated.

The Railgun. Rapid progress has also been achieved in the past year on the electromagnetic railgun---a device for propelling a smart bullet on collision course towards the enemy warhead at extremely high speeds. The high speed produced by the railgun means that the gap between the intercepting "smart bullet" and the warhead will be closed very rapidly. This increases the effectiveness of the defense and makes it more leak-proof.

One line of progress in this technology involves the ability to fire many bullets from the railgun in rapid succession. A recent test succeeded in firing the bullets at the rate of 1 every 5 seconds, whereas a year ago, the best that could be done was one shot every 2 or 3 days. The desired rate of firing is several shots a second. As a result of this success, it now appears that no obstacles stand in the way of achieving the necessary rate of firing in the fairly near future.

There is an interesting reason why rapid firing of the railgun is so difficult. The reason is that enormous currents of electricity---about a million amperes---pass through the railgun every time it is fired. Building switches that can handle such currents, while opening and closing many times a second, is a formidable challenge---but one that railgun designers appear to be meeting.

Another problem with railguns is that they get a bullet up to a speed of more than 10 miles a second in a fraction of a second. This subjects the bullet to enormous accelerations in excess of 100,000 g's. Building a computer for the brain of the smart bullet" that can withstand the tearing stresses of this acceleration is another formidable technical challenge. However, this effort is also meeting with success. In tests during the last year, electronic components were tested at accelerations well above 100,000 g's and survived.

The SCRAMJET. The concept of a new kind of rocket engine called the SCRAMJET ---which can be loosely described as a cross between a rocket and a jet engine--- was recently tested successfully in the laboratory. The design of this engine is based on elaborate calculations with Cray supercomputers that could not have been done 10 years ago, and possibly still cannot be done in a reasonable time anywhere in the world except in the U.S. The test points the way to a spaceplane the size of a 707---the so-called Transatmospheric vehicle or TAV---that can take off from an airport, go into orbit, and return to the earth to land again at an airport.

The SCRAMJET holds the promise of reducing the cost of putting heavy weights into orbit from thousands of dollars a pound (current Shuttle prices) to tens of dollars a pound. This may be the most important technical achievement in the SDI program to date, because a decrease in the cost of orbiting payloads by a factor of 100 will tilt the ratio of costs of a space-based missile defense irrevocably in favor of the defense over the offense. It is fair to say that with this kind of reduction in the cost of orbiting payloads the Soviets can never hope to overwhelm a U.S. defense by building up their offensive arsenal.

Some of the reasons behind this conclusion are: At the low cost-to-orbit made possible by the SCRAMJET, defensive satellites can be heavily armored against Soviet attack, equipped with substantial amounts of gunnery for a "shoot-back" defense, and loaded with large amounts of fuel to enable extensive maneuvering out of the path of any approaching threat. Also, at these low costs-to-orbit, decoy satellites can be orbited in substantial numbers, further decreasing the vulnerability of the U.S. defensive system.

## COUNTERMEASURES

The Space Mine. The OTA report discusses many possible Soviet countermeasures to a U.S. space-based defense. One is the space mine (pp. 175-176)---a small, covert satellite designed to trail our defensive satellites and destroy them on command.

The trouble with this idea is that the atmospheric drag acting on the space mine ---which depends on shape, size, and so on---is never precisely the same as the drag acting on the satellite it is stalking. As result of the difference in air-resistance, the space mine and the satellite draw apart during the course of numerous orbits. In order to keep close to its quarry, the space mine must occasionally fire a small rocket or thruster to slow down or speed up. When it does that it gives its position away to the infrared sensors on our surveillance satellites. Once the space mine is discovered, it can be destroyed if it gets close enough to our defensive satellites to constitute a threat to them. International law recognizes the legality of such actions if they are necessary to protect a nation's defensive forces.

Not only does the space mine betray its presence whenever it tries to maneuver, but it is readily visible to our ground radars as well as the radars on our satellites. "Stealth" technology will not work for a space mine, because "stealth" is directional; it only works if the radar beam is coming from a single direction. But a space mine in orbit will be inspected by our ground radars from many different angles as it passes overhead. And it will also be inspected from many different angles by the radars on the satellites in our space-based surveillance system. For all these reasons, space mines will be very visible to us, and can be picked off at any time when we judge them to be a threat.

There are other problems with the space mine. A space mine must have very elaborate tracking instrumentation---nearly as elaborate as the instruments and computers we plan for our defensive satellites---in order to stay on the trail of its quarry. If it only uses, say a simple heat-sensitive device for tracking and homing, the satellite it is tracking can toss off a hot flare as a decoy, and the heat sensors on the space mine will direct it to follow the flare.

In addition, the space mine must also carry a large amount of fuel to provide it with maneuvering and tracking ability over a long period of time---months or years. This means it must not only have complicated and expensive instrumentation, but also be quite heavy. The OTA report describes space mines as "an easier and more accessible technology" than the satellites they are tracking, but the report is very far off base in this matter.

The consensus among professionals in the defense science community is that the space mine is not to be taken seriously as a Soviet countermeasure to our defense. In fact, the SDI considers space mines to be so far outside the range of usefulness as a countermeasure that it has no programs for their construction, either in the U.S. program directly or as a part of the SDI's "Red Team" studies simulating possible Soviet responses to our defense.

Fast-Burn Boosters. The fast-burn booster is another possible Soviet countermeasure that receives very full discussion in the OTA report. Fast-burn boosters also received prominent attention in the report to the OTA by Dr. Carter, being singled out in that report as perhaps the most valuable countermeasure to a U.S. defense from the Soviet point of view. Page 6 of the report by Dr. Carter States,

> "Fast-burn boosters would therefore be a potent, even decisive, countermeasure against almost all concepts for boost-phase intercept."

What is a fast-burn booster and why is it important to the Soviets? The fast-burn booster is a high-acceleration ICBM that boosts its payload to full speed in less than one minute, in contrast to several minutes required to reach full speed for the existing Soviet and American ICBMs. After each ICBM burns out, the "bus" on top of the ICBM, which carries all the warheads, separates and begins to deploy its warheads, one by one. All our defense plans are based on the hope that we can get a good shot at the Soviet booster before it burns out. If we destroy the Soviet rocket before burnout, while it still has all its warheads on board, we may get as many as 10 or more warheads at once.

The first advantage of the fast-burn booster to the Soviets is that it shortens this critically important time in which we can catch the Soviet missile with all its warheads aboard. The second advantage is that a fast-burn booster burns out in the relatively dense air of the lower atmosphere. This protects the Soviet rocket from some of our most promising defensive weapons, such as the neutral particle beam, which do not penetrate the atmosphere.

But there is a serious flaw in this reasoning, which makes the fast-burn booster useless as a Soviet countermeasure. The flaw in the reasoning involves the bus. After the booster burns out and falls away, the bus carrying all the warheads then proceeds to deploy those warheads. But the bus cannot deploy them immediately, for the reason indicated below; it must wait until it has climbed well above the atmosphere. During the relatively long period of time---many seconds---in which the bus is climbing to higher altitudes, the bus and its warheads are exposed to our attack. This lengthy time interval for attack wipes out most of the advantages the Soviets had hoped to gain by building their fast-burn in the first place.

Why must the bus wait to deploy its

warheads until it has climbed above the atmosphere? If the bus does not wait this long, but deploys its warheads a short time after burnout and while it is still in the atmosphere, two terrible things happen from the viewpoint of the Soviets. The first one is that deployment in the atmosphere enables us to tell the warheads from the decoys very easily, because the decoys, which are necessarily lighter in weight than the real warheads, will be held back more by air resistance. If we know which are the real warheads at the very start of the attack, we can concentrate our fire on them and greatly enhance the effectiveness of our defense.

The second disadvantage for the Soviets, if they deploy their warheads in the atmosphere, is that the accuracy of their warheads is considerably degraded because the warheads are buffeted by aerodynamic forces. A decrease in the accuracy of the warheads on the Soviet SS-18 from their current 250 yards to, say, 500 yards would enormously reduce the effectiveness of these warheads against hardened military targets in the U.S. That is an eventuality which the Soviets would certainly be determined to avoid at all costs.

The only recourse the Soviets have for avoiding that loss of accuracy is to install a separate guidance and control system---that is, gyroscopes, accelerometers and small rockets---on every warhead. In other words, each warhead rides on its own bus---a minibus. Then every warhead can keep its own eye fixed on the target, so to speak, and compensate for deflections from its course caused by the atmosphere. But adding a minibus for each warhead increases the weight of the warhead, which means the missile cannot carry as many warheads. It is estimated that the number of warheads would be reduced by a factor of 2 to 5. That would represent a major reduction in Soviet first-strike potential, and a great plus for American security.

The OTA report acknowledges these difficulties when it states on page 177, "However, the post-boost vehicle (*i.e.*, the bus) cannot usefully deploy within the atmosphere..." But on page 208 the report states that the Soviets could overcome the vulnerability of bus and warheads by "a rapid dispensing technique," *i.e.*, prompt deployment after burnout. The statement on page 177 is in accord with technical realities; the statement on page 208 is not. The confusion indicated in these contradictory statements raises questions about the value of this analysis as a contribution to the technical issues involved in missile defense.

(A recent report to the SDI from the McDonnell-Douglass Corporation indicates other very serious difficulties with the fast-burn booster. Because of the very high accelerations required for this booster, small departures from its proper course cause oscillations in the guidance system that build up and cannot be controlled, leading to losses of accuracy and possible destruction of the booster by aerodynamic forces. No guidance technologies known available or in prospect can deal with this problem, according to McDonnell-Douglass.

The consensus among defense scientists

who have been taking a hard look at the matter is, as noted, that the fast-burn booster has little or no value as a Soviet countermeasure. In fact, as in the case of the space mine, the SDI regards fast-burn boosters as so useless that it has no plans for their construction in any of its "Red Team" research programs aimed at investigating possible Soviet countermeasures.

*The Fake Booster*. The OTA report offers several other proposals for consideration as Soviet countermeasures. One is the fake booster. This is proposed as an inexpensive replica of an ICBM that would be set out in great numbers in the Soviet missile fields, to be launched at the same time as the genuine ICBMs in a mass attack. The idea is that our defense, turning to shoot at everything in sight, will be overwhelmed by the multitude of fake boosters, and most of the real ICBMs will slip through unscathed.

The trouble with this idea is that a fake booster must have a genuine guidance and control system because our sensors will observe its path, and if it weaves about as it leaves the surface of the earth, or departs from a realistic trajectory in any way, we will know it is a fake. It must also have the same size and appearance as a genuine ICBM or our sensors will, again, notice the difference. Its engine must produce a rocket flame of the same size and appearance as the flame from a genuine ICBM, or we will notice *that* difference. Finally, it must rise from a silo constructed like a genuine silo, or our sensors will note that also.

In other words, the fake booster must possess all the attributes of a real ICBM ---except that it will lack nuclear warheads. But the warheads are only 10 percent of the cost of an ICBM. If the Soviets spend 90 percent of the cost of an ICBM on a fake, why not add the warheads for another 10 percent and have the real thing?

The OTA report identifies several other Soviet techniques as posing serious problems for the U.S. defense. Most are concerned with the so-called boost phase of the defense, which attacks the Soviet missiles as they rise from their silos or launch tubes.

For example, the report suggests that pre-positioning of nuclear weapons in orbit could be a valuable Soviet strategem because this would reduce the warning time for nuclear attack to the few minutes required for re-entry from orbit. Also mentioned are bombs smuggled into the U.S. in suitcases, diplomatic pouches or across borders.

In our opinion, none of the general proposals for saturating or overwhelming this defense---e.g., "concentrating many RV (warheads) on a few cities" (p. 174)---has any plausibility in the sense of offering military, political or economic gains to the Soviet Union. It is our understanding also that none of the specific technical proposals---with a few exceptions such as decoys, which are under intensive study in SDI---has survived the test of serious scrutiny by defense experts. In fact, professional studies of the countermeasure problem indicate that while some countermeasures, such as decoys, warrant attention, especially in terminal layers of the defense, there is no effective countermeasure known to the boost-phase defenses currently under serious consideration in SDI.

Mr. COURTER. A third comment, at least your comments today seem to talk in terms—and most people do this—the Soviet threat, in terms of the United States and the Soviet Union forever basically being the only nations in the future to have serious offensive nuclear capabilities. But I argue that that is not going to be the future, unfortunately.

There is going to be probably a number of other countries, some of whom we don't perceive to be extremely stable, that are going to one day, regrettably, in the future have offensive nuclear capabilities.

And I am wondering what type of a world we would be living in if 10 years from today Mu'ammar Qadhafi in Libya had offensive nuclear weapons.

There are suitcase bombs, the possibility, but the point is, there are other scenarios besides the Soviet scenario, and that is a Third World country having nuclear weapons or a launch by an irrational act of a single commander of the Soviet Union, launching four or five missiles.

If we had no defenses our only option would be to watch them come and see tens of millions of Americans incinerated, or No. 2, kill tens of millions of innocent Soviets who had nothing to do with this, or a launch by computer error or by mistake.

It seems to me, unless we deploy a defensive system, even if they would not be capable of totally shielding the United States from a total Soviet onslaught, it could save tens of millions of Americans in the case of a launch by technological mistake or error.

You can comment on my comments, obviously.

I have a couple of questions, a few, if I may, and then I have some other ones for the record.

From your testimony, I have difficulty in understanding your conclusions. You raise a lot of very intriguing questions, and I have attempted to raise them myself in my own analysis of scenarios, but it would be helpful to me if I knew what your conclusions are. But maybe that wasn't the point of your testimony, was to raise interesting questions, but not really come out with a position.

And my question is, do you have a position? Should we research? What levels of research, et cetera?

A couple more, if I may, and you can take notes on these.

The OTA says on page 3 of the statement that the present Ballistic Missile Defense Program is technologically limited and I am wondering whether anybody shares my view that possibly, because of the reduced funding that the Congress passed last year and inevitably and undoubtedly, reduced funding this year, it is also funding limited, not only technology limited.

Second, does the OTA feel that apparent SDIO, Strategic Defense Office, a movement toward early deployment for technologies, and it is inescapable that they are moving in that direction—and the question is, do you believe that that is a result of technological advances, surprises, moving faster than they anticipated, or do you think it is caused by funding restraints, and therefore, they want to move quicker than originally anticipated?

On page 4 of the statement, concern is expressed about our tests and demonstrations which might have an eroding effect on the ABM Treaty.

And I raise the question whether the panel feels that Soviet behavior with regard to their efforts at strategic defense may have an eroding capability on the ABM Treaty, as well.

And finally, would there be any value in the United States and our allies deploying an effective defense, either conventional or strategic, against air breathing threats, like cruise missiles and manned bombers, and if not, I wonder if you would answer the question why the Soviet Union is spending so much money, so much effort on an air defense.

The rationale is, and this probably was the reason that we decided not to build air defenses in this country, and the thinking is, if you can't stop a missile, why bother stopping a bomber, and therefore, it makes no sense in spending tens of billions of rubles or dollars in building air defense, but if that logic is correct and unescapable for the United States, I wonder if it is not unescapable for the Soviet Union and if they are continuing to spend untold sums of money on a robust air defense, it is only logical to do so if they one day want to stop missiles as well.

Mr. KARAS. Yes, sir. First to try to answer your questions in order—we did not comment extensively on the question of accidental, irrational, or third country launches.

This is a consideration that one would want to fold into the entire decision about BMD. It was at the periphery of the debate going on about it. It is not a negligible issue, but we did not analyze that issue.

With respect to conclusions, we were careful not to recommend one course or another to the Congress about the R&D Program, but we saw it as our task to explore the implications of the options, so the Congress could make its decisions rather than us tell the Congress what it should do.

Your question about whether we are technology or funding limited—now, actually, I think the funding limited option that we put in there was sort of put in there so that we could think about the fact that maybe that is where we are going willy-nilly.

That is, de facto we are ending up with a funding limited program, and General Abrahamson has been explaining how he has been dealing with that funding cutback and the technologies which he, at this point, sees as somewhat less promising and would like to pursue if he had the money, but will not, because he doesn't have the money.

So, we could agree that if the program as proposed by the administration was more or less technology limited and they are getting less money than they asked for, it is now more funding limited than technology limited.

With respect to the question about SDIO moving toward early deployment decisions. They had hinted at this and the hint was in terms of citing more rapid progress in some areas than they had previously anticipated.

In General Abrahamson's recent testimony, however, he continues to say that their objective is to achieve the information necessary to make a decision some time in the early 1990's.

It might be, however, that he believes that some of the technologies, such as free electron lasers, which they had previously believed would be more suitably deployed in 2010, might be deployable in 2000 or something like that.

I don't know what detailed conclusions he has come to on that and whether there is any political component, any tendencies toward that. I have no knowledge or wouldn't be willing to try to guess their motives, in any case.

And finally, yes, it is very clear that Soviet behavior with respect to certain provisions of the ABM Treaty has contributed to the erosion of that treaty, no doubt about it.

If we wish, in this country, to try to preserve that treaty regime because we believe it is in our interest to do, and that seems to be the current policy, at any rate, then it would be my personal opinion, rather than an OTA finding here, that we should try to do something about that erosion.

In any case, I don't think anybody could argue with you that their behavior has not been eroding the treaty.

With respect to the issue of air defenses, we did point out that how deeply we want to go into air defenses depends in part on our objectives for having strategic defenses.

That is, if we wish to complicate Soviet first strike attacks using ballistic missiles, that may be worthwhile doing in itself, whether we build air defenses or not.

If our goal is to try to virtually, if not totally, to eliminate the Soviet Union's ability to deliver weapons on the United States, and indeed the Soviets have accurate air breathing weapons, possibly in the future—accurate cruise missiles, then we would need simulataneously to deal with that threat.

With respect to Soviet strategic defense efforts, they spend a great deal on defense against air breathing threats, and part of that can be attributed to their theater responsibilities and objectives, somewhat different from our's, but for part of it—one can only share your puzzlement.

That is, they have clearly spent many billions on it, and yet, the strategic air command believes that U.S. air breathers are going to be viable into the indefinite future, so apparently we think we can penetrate.

Mr. **Courter**. That is not true. I never heard anybody testify that our air breathers can penetrate into the indefinite future.

Mr. **Karas**. I am sorry for what was probably an overstatement. I was making an exaggerated inference from what I was trying to allude to which is that apparently there are plans to go ahead with advanced technology bombers, advanced technology cruise missiles, and the U.S. Air Force continues to believe at least for those elements, that they will continue to penetrate for the foreseeable future. Certainly "indefinite future" is an awfully long time, and it was silly of me to say that.

Dr. Sharfman.

Mr. **Sharfman**. If I might elaborate a little bit on some of those points.

First, with regard to the comment regarding proliferation of Soviet offensive forces, in fact, 6 years ago, when there was a debate over the basing of the MX missile in multiple protective shelters, the so-called racetrack approach, OTA did a report on that subject and called attention very vigorously to the fact that proliferation of Soviet RV's might negate the effectiveness of the multiple protective shelter basing of MX missiles.

Mr. COURTER. It would be an incentive to proliferate, and Midgetman is?

Mr. SHARFMAN. That is not necessarily the case.

Mr. COURTER. What is the difference between the Midgetman and the MX racetrack?

Mr. SHARFMAN. In the case of the MX racetrack, you had a very large but finite number of points at which the MX missiles could have been, and the way the Soviets could have attacked that would have been to fractionate their force, to have more RV's per missile.

Mr. COURTER. How do you think they are going to destroy Midgetman?

Mr. SHARFMAN. In this case, the answer would be a barrage which would require not proliferating their RV's, but increasing their total amount of megatonnage which would presumably require an increase in their throw-weight. That would be one possible Soviet response.

Mr. COURTER. It could be a combination between increasing throw-weight and increasing numbers. You hold with the statement that MX would have encouraged proliferation in Soviet offensive missiles, but a mobile missile does not?

Mr. SHARFMAN. The argument that we made at the time of the MX debate some years ago was that MX deployment could have encouraged the Soviets to fractionate, proliferate the number of RV's on a given missile force and might also have encouraged them to increase the overall size of their missile force, the number of missiles, or the throw-weight.

We got into the argument as to whether it would be cheaper for the United States to build more shelters or the Russians to build more RV's.

You may recall that the Defense Department at that time testified that it would be 10 percent cheaper to build a shelter than to build another RV and our report was a little bit skeptical about a cost-effectiveness margin that narrow and about whether the Russians would agree with that particular calculation.

On Midgetman, we have not at OTA gone through the detailed calculations based on detailed designs and so forth that we did with the MX, and so it is harder to be certain.

But what one can say as a generalization is that, given enough throw-weight and enough megatonnage and a willingness to take the consequences of doing so, the Soviets could barrage the entire area where Midgetman could be deployed in such a way that they would be able to destroy whatever Midgetman missiles happened to be there.

But the calculations of how much that would take, and therefore, whether this is a plausible rather than just theoretically possible Soviet response——

Mr. COURTER. You know what the hardness is going to be, 30 pounds per square inch.

Mr. SHARFMAN. I know what is in the design. As far as I am aware, no one has reached the point of really doing tests on a prototype.

Mr. **McCloskey** [presiding]. I believe Mr. Battista has a comment that could clear some of this up.

Tony.

Mr. **Battista**. We have done some calculations. I agree with you on the MX multiple protective shelter, that indeed that could have resulted in proliferation. Similarly, close spaced basing could have resulted in proliferation.

The numbers on the Midgetman, assuming 30 pounds per square inch, although the numbers will be harder than that, the numbers so far indicate the exchange rate is definitely in favor of the small mobile, principally, because at 30 miles an hour, you would generate about 44,000 square miles of land area, plus.

And the numbers so far indicate that with the 18 forces and the SS-19 force, if the Soviets were to, in fact, double the number of RV's, they could still, at best, realize only 50 percent damage on the small mobile.

That is, 50 percent of your force still survives with 17,000 RV's. The problem with fractionation is that is costs you in accuracy. They can go to probably as many as 30 RVs on the 18, but they lose the accuracy that they have got today, so the evidence so far suggests, not proves, that the small mobile, indeed, discourages proliferation because of the exchange rates.

If you can generate that much land area, that is, MX close base basing, we are quite the opposite.

Mr. **McCloskey**. Thank you, Mr. Battista.

Mr. **Sharfman**. The calculation has to be done. How much would the Russians have to proliferate to overcome a given Midgetman deployment? What would it cost them? What would it cost us to counter in such a way as to overcome that?

You can't answer that question as a matter or principle. You have to look at the numbers.

Mr. **Courter**. Let me interject something. If one of the goals of the SDI office is to make a determination that it is cheaper to defend than to blow up, that the cost exchange ratio favors defense, we will then—for sure there would be no incentive to proliferate, correct or not?

Mr. **Sharfman**. If the Russians agreed that we had succeeded in doing this.

Mr. **Courter**. Same thing with the Russians agreeing with our Midgetman. I mean, if the Midgetman does not encourage proliferation because we have made calculations and studies on strategic defense, we are not going to go forward with it if you can defeat it by more cheaply proliferating.

That is one of the goals of the research program. But if that goal is achieved, if we, with reasonable certainty, conclude that it is unfavorable to attack defenses because the cost exchange ratio favors defense, well logically there is no incentive to proliferate, correct?

One says yes, and you are not so sure. One says no.

Mr. **Sharfman**. Logically, that is correct.

Mr. **Courter**. Oh, otherwise it is not correct. I thought logic helped out.

Mr. **Sharfman**. You have got three cases here of trying to calculate cost exchange ratio, the old MX MPS scheme, the Midgetman, and a BMD system. In the case of the old MX, the Defense Department presented to the Congress calculations that the cost exchange ratio was in favor of the MX against the attacker.

The Defense Department calculations showed this ratio was 1.1 to 1, a very close ratio, and we at OTA were skeptical about the precision of those calculations and wondered whether the ratio might not be the other way, but if we had deployed an MX MPS, what would have mattered for the Soviet response was the Russians' calculation.

For the case of Midgetman, Mr. Battista has said that calculations show the exchange ratio would be very strongly in favor of the Midgetman and against those who would attack it.

I have not gone through those numbers and can't comment on that, but if it is a robust finding, and if the Russians' calculations would come out in the same place, then deploying Midgetman would not encourage proliferation.

In the case of a SDI deployment, no one has done those calculations, yet.

Mr. COURTER. I understand that.

If the research concludes that the cost favors defense, then there is no incentive to proliferate. That is all I am saying.

Mr. SHARFMAN. That is right, unless the Russians feel that it is so important to them to be able to attack us that they are prepared to outspend us.

There are other areas of military forces where they have outspent us.

Mr. COURTER. If that is the case, the same thing must hold with respect to a mobile missile. You got to have it both ways.

Mr. SHARFMAN. Well, the Russians might not feel it was as important to attack all of our ICBM's, as they feel it would be as important to attack some targets in the United States.

Mr. COURTER. We can drop that.

Mr. SHARFMAN. To turn to another one of your initial comments, as to the OTA conclusion, as Dr. Karas said, we did not make a recommendation as to what would be an appropriate research program. We don't feel that that is our role.

We did, however, have a series of findings which we believe are reasonably robust. They are listed at the end of the summary which we asked be put into the record, and they include such propositions as that the capability of the United States defense depends critically upon the offense that it has to deal with. Therefore, it makes a big difference in figuring the capability of the defense whether the Russians cooperate in a transition to defenses—and it is the administration policy to get them to do so—or whether the Russians do their very best to overcome the defenses, in which case it is certainly more probable that they would succeed in getting some missiles through.

Mr. COURTER. I recognize that, but my point is that the same assumptions are with mobile missiles. If the Soviet Union advances their technology such that they have warheads that are movable, that you can direct, and then sense where the Midgetman is roaming around, Midgetman may not fill the bill.

So, you can't say, well, defense is a question mark, because it depends on what the Soviet Union does.

Well, Midgetman may be the best way to go, but it also depends on what the Soviet Union does.

Mr. SHARFMAN. Yes, but there is one major difference in principle between a defense of ICBM's, whether you are defending them actively with ballistic missile defense or passively—through mobility or concealment, as the submarines do, or whatever—and defending the entire country, and that is, we can accept a certain amount of attrition in our offensive forces.

Back in the MX MPS days, the days of the debate over the mobile MX, the usual number that people talked about was that if the system could insure the survivability of half of our MX missiles, why, the half that survived could do such enormous damage to the Soviet Union that deterrence would be preserved.

And I presume the calculations made about Midgetman all assume that the Russians could destroy a certain number of Midgetman, but if a certain number survived, that would have a great effect for deterrence.

Now, we wouldn't feel the same way about saying, well, if we can save half of our cities, then we don't mind if the other half are destroyed.

You can make the argument that it is better to save half of our cities than to save none.

Mr. COURTER. While you are saving your population, you are going to go about saving your deterrent, as well?

Mr. SHARFMAN. Presumably so.

When you are talking about protecting our retaliatory forces, we are accustomed to thinking in terms of a fraction surviving and of the attack price which the Russians must pay to destroy a certain percentage of our offensive forces.

When we are talking about protecting the country as a whole, we are concerned with what survives and what is killed rather than with the price the Russians have to pay to accomplish that.

I won't go on with our other eight findings.

Mr. COURTER. I know that Congressman Darden has some penetrating questions, and he is chafing at the bit.

Mr. MCCLOSKEY. You are doing a great job there, Jim. We will turn it over to Congressman Darden.

Mr. DARDEN. Thank you very much, Mr. Chairman, and Mr. Courter. I regret that we have to terminate this discussion, because it is fascinating. I would like to continue it later on.

Gentlemen, turn very briefly to the less complicated issue of ASAT, and get your odds on a couple of matters here that have concerned me somewhat.

To recap what you said earlier, you said that the Soviets have tested 17, 18 times, and we have only tested twice. As I recall, our system is air-launched, and theirs is ground-launched.

And my first question, and I have a series of questions, and maybe we can cover them as quickly as possible, is the Soviet ground-launched ASAT system transferable to a space-based platform?

And second, if you compare and contrast the advantages of our ASAT system with theirs and give us an overall assessment, comparison of the relative effectiveness of each system.

And finally, could you give me an assessment of how vulnerable our U.S. military and communications satellites are at the present time, and in the immediate foreseeable time?

Mr. CALLAHAM. I will be glad to try to respond to those, sir.

It is our view—the Department of Defense's view—that to make the present Soviet ground-launched nonnuclear kinetic interceptor space launchable, would be a major change.

And I don't think that anyone would think the Soviets would do it precisely that way. However, in the "Soviet Military Power" publication by the DOD, they estimate the Soviets do not see the best direction for improving their ASAT capability to be an improvement of their current system. They do project the Soviets might see that space-launched kinetic kill vehicles would be one way to go, and they might develop such a thing.

They even show an artist's illustration of a Soviet space plane launching such weapons. They do not assess that there will definitely be such a development, but there might be.

As regards the advantages of our system versus their system, there are several advantages that come to mind, and we could be more specific perhaps in classified, closed session.

Our estimate of their altitude capability and the altitude capability the United States has demonstrated are both classified. However, it has been indicated that the Soviet ASAT could attack higher altitude targets than our MV is estimated to be capable of.

There is a subtlety there: One has to consider the orbital inclination of targets, and the altitude which the Soviet ASAT can reach depends upon the inclination of the target it is shooting at. That is less true with our system. Ours is less subject to that.

With the airlaunched system, another fact to be considered is that it can achieve perhaps greater surprise in attacking targets. Its flight time to the target is generally not as great, if it attacks a target near perigee, for example.

The operations are very different, and with the air-launched system, one can maneuver the air launch vehicle over or close to the ground track of the satellite. We could compare this to some types of groundbased weapons. One would not have to wait as long for opportunities to attack particular satellites, since you could fly out with aircraft.

Another advantage has to do with the kind of kill mechanism, not the fact that it is air-launched, but the fact that our homing vehicle is just that, a homing vehicle. It kills by direct impact of the target, and the use of the target's kinetic energy to fly into it. The weapon goes in the path of the oncoming satellite rather than trailing it, which allows a very small warhead to be effective. That is perhaps not so important—how you do it—as the fact you can do it.

Have I answered your questions?

Mr. DARDEN [presiding]. I asked you the second part of that question about the immediately foreseeable future.

Mr. CALLAHAM. One other point first: The Soviet interceptor—one version of it—may sense its target differently than ours would, and there would be a difference in ability to countermeasure.

As regards the vulnerability of U.S. communications satellites, a detailed discussion of this matter cannot be made here in open session.

However, I can say, for example, it is known the United States and the Soviet Union have a lot of communications satellites, not necessarily military ones, in geostationary orbit, and neither the current kinetic Soviet interceptor, or the United States weapon, is to be capable of attacking those satellites in geostationary orbit.

There are a number of Soviet communications satellites, but not United States, in highly elliptical orbit, that get very close to the Earth in the Southern Hemisphere, but high above the Earth in the Northern Hemisphere, and we have said the U.S. miniature vehicle system would not be capable of attacking those Soviet spacecraft in those orbits, as long as the U.S. system is based as planned in the Northern Hemisphere.

That is probably all we should say in open session about vulnerability of communications satellites, specifically. There are, in addition to Soviet kinetic energy interceptors, several hypothetical Soviet capabilities that could be discussed as well.

Mr. DARDEN. Thank you very much.

Mr. Bennett.

Mr. BENNETT. Two things have come up here which I would like to comment on very briefly. One has to do with the assumption that the Midgetman is a thing that is going to be targetable at automatic, and as to the size of it.

Just because a political decision has been made on an unauthoritative committee basis that we have a Midgetman doesn't necessarily mean it will wind up being that small, because the question is the mobility really basically, and second, how ascertainable it is.

I might have favored a mobile missile for at least 20 years, and I never set out to try to get one that was small. I realize the argument for small missiles, one warhead, but that doesn't necessarily mean that this is going to be that kind of a missile.

It might be a large missile, one that would travel on every highway, every rail in the United States. That is what I would like to see, not necessarily large or small, but I would like to see it not capable of being blasted off because of a concentration on Harmony Churchyard in Fort Benning, or something like that.

I would like to see it where it would be something comparable to the Trident missile, so I don't think we should build ourself into an inadequate defense system by repeating that it has to be small and by geography, you could knock it out.

My other point is based on just common sense, certainly common sense of people that have to do with having fought, and that is, why would you think that a choice is involved at all, between having defensive and offensive weapons?

Who are you going to make abide by that thinking? Nobody has ever abided by it before—10 percent, 5 percent are still going to get through, and just to say that dollarwise, you will win on one side or the other, while we are doing all kinds of very expensive things in our country that don't make all that much sense, the Russians do the same.

They produced a submarine made out of titanium, which has very marginal benefits to us. It is a little better, and why would you think that if the SDI proved only to be 90-percent effective, that both sides wouldn't have it, and both sides would increase, proliferate, of course they are going to proliferate.

Proliferation is not limited to one weapon. Why would you think you wouldn't have both? They won't make a choice, either/or.

If there is a chance that 5 percent will still get through, they will have both. I think you have to look at the realities of it, and we are approaching a system, the SDI system is going to be on both sides, each side is going to have it, very expensive, and they will also have all the offensive weapons as well.

Just because you have a defensive system, not perfect, doesn't, in my opinion, lead at all to the hope that there will not be offensive weapons on the other side, because nobody is that dumb.

Is there something wrong in my thinking on this?

Mr. **Karas**. We pointed out in the report that there are serious arguments to be made about the benefits of less than perfect defenses, and the essence of this argument is that today, with ballistic missiles totally unopposed, for those targets that the Soviets want to attack with ballistic missiles, they have a free ride, and depending on how you calculate today's uncertainties in their attack, they have some level of confidence that they will destroy those targets.

It is generally conceded our 1,000 Minuteman silos are becoming increasingly vulnerable. Insofar as it is of strategic value to us, to increase the amount of uncertainty the Soviets have about the possible success of such an attack, then you could argue that these fairly high levels of defense, 90 percent, even less, would add that deterrent factor to our current deterrence against the Soviet Union.

You are not saying you can keep them from getting any city at all, they can still get any number of cities anyway, if not the particular ones——

Mr. **Bennett**. The only reason I brought this up is because there seemed to be a feeling, not necessarily you have this feeling, a general feeling that possibly the Russians are confronted with choosing between systems, and maybe we do it, but I doubt it.

I doubt if we would abandon offensive weapons.

Mr. **Karas**. The argument is that the choice they now have to make is whether they can continue to have the same military objectives for having their ballistic missiles that they now have, which many believe would be a substantial and important difference.

Mr. **Epstein**. To connect something mentioned before, the utility of a less than perfect offense against a third country, that wasn't the construction of the issue, and we didn't spend a lot of time on that.

In the chapter where we presented our five different research options, we would retain the capability if we choose to counter a small, third country or accidental attack on at least four of those options.

Under the existing ABM Treaty, we retain the right to deploy 100 interceptors, and if they were sufficiently long range, they might provide some capability.

Defending against small attacks is a separate question.

Mr. **Courter**. The interceptors have to be stationary, and that is going to handicap them.

Mr. **Epstein**. If the interceptors had sufficiently long range, it might be possible to provide some of that capability, nevertheless.

Mr. **Darden**. Thank you very much.

Mr. Bennett.

Mr. **Bennett**. Nothing further.

Mr. **Courter**. One last question, from my recollection in your testimony, there was a statement that the Soviet Union is better able to deploy a nationwide ballistic missile defense system today than the United States, and I think that is—I am pretty sure that is what you said.

That would lead me to believe that with the type and level of spending that the Soviet Union is devoting toward strategic defense, which is more than we are spending for it, that uncomfortable situation is going to be worse 5 years from today than today, unless we fully fund the strategic defense initiative.

And if your statement is correct, that they are much more capable of breaking out today, and it is also correct, as I assume, that the Soviet Union is spending more money on strategic defense than we, it is going to get worse, so it seems to me you made a very good argument why we should robustly research strategic defense.

Mr. **Karas**. It would depend in part on what kind of strategic defense we would be funding. The other side of this coin about the Soviets' ability to deploy something nationwide and in the nearer term is that our most rational, immediate response would be to deploy both the kinds of penetration aids we now have and additional penetration aids.

Although they could deploy something nationwide, it wouldn't be all that effective against our responses. As to long-range ability to deploy something, it could be argued that in order to get a near-term deployment option as a hedge against Soviet deployment, or response to potential Soviet deployment, we should devote less effort to research on the long-range technologies, but should devote more to preparing the kinds of technologies we now know how to do. This was the thrust of what we labeled, and some people have argued for this, the "combination approach", so it is not necessarily more money toward strategic defense, but what kinds of systems, in what framework would you like to be able to make a decision.

Mr. **Darden**. Thank you very much.

Mr. Battista, before we close, you needed to make a point.

Mr. **Battista**. I think what you are missing, including what so many other people have missed, and the administration, the general policy that suggests how a SDI will relate to a small mobile, our offensive systems.

That was not covered in your report. What you failed to report out to Mr. Courter also was the fact that SDI has a higher fragility index than small mobile. I can lose half of my small mobile force and still retaliate, and if I lose a vital piece, surveillance acquisition, target or kill assessment piece of the SDI, I am kind of—well, I am in deeper trouble.

I don't have the command and control necessary to go along with being able to pick off those incoming RV's. The reason for the higher budget relates to the fact that we have to explore ways of getting that index fragility up.

Have you come to the same conclusion, that no one in the administration, and that is not critical of this administration, but previous ones as well, have failed to address the synergism, and I hate that word, they talk about how we got a synergism among the legs of the triad, but specific synergism along offense and defense often gets ignored.

Mr. **Karas**. That has been hard to do in the absence of specific defense architectures. You can talk generally about the relation between offense and defense.

For example, it seemed to me, and this is a personal opinion, that we have not been looking too closely at the connection between the Midgetman and the restrictions on ABM's that we now have.

What we are doing with the Midgetman is trying to preserve a certain relatively small number of warheads by mobility. If those warheads must face a heavy Soviet BMD system on the other hand, we may not have gained much by the mobility.

Mr. **Battista**. I can understand a small mobile how it relates to arms control, if I want arms control reductions, as long as both sides can count holes, deterrence becomes a subjective factor, whereas if you can hide things, and take away the position certainly, then you can substantively talk about arms control reductions in the outyears.

I have no idea, for example, when people talk about early deployment, of what? It was this committee, for example, that rammed short wavelength laser technology down DOD's throat in 1983.

There is no doubt in my mind that we can put a laser out there in the next 24 months, what about C3 that goes with it? When people talk about early deployment, you suggest that the SDIO is hinting to an early deployment. Of what?

I know of no gallium arsenide that survives a nuclear—today that is where we are putting this money into it. Early deployment of what, again?

Mr. **Karas**. Yes, there are two to three schools of early deployment, and the suggestion I made, and it was a parenthetical one in my testimony, that the SDIO may be looking at somewhat earlier deployment of some of the technologies than they had previously predicted, but not early deployment in the sense of having something deployed by 1992.

There are those who think we should have something deployed by 1992, and they must not be talking about space-based lasers, ground-based lasers or any of the more exotic technologies.

They must be talking about advances they believe could be made with kinetic kill vehicles, nonnuclear or, what would be easier to do, nuclear warheaded interceptors.

There is a division in early deployment schools between those who think we should have this capability as a hedge, so that we could deploy something like what the Soviets could deploy, a nuclear-type interception as a hedge against their doing it, and hoping to deter them from doing it because it wouldn't be a practical thing, versus those who believe that small increments of defensive capability now will add enough uncertainty to Soviet attack plans, that such a partial defense is worth buying.

We have not tried to judge that. That is a judgment for the Congress to make—whether they think what we would pay would be worth what we would get.

They are certainly not talking about early deployment of space-based lasers, or ground-based lasers, or even space-based kinetic kill vehicles, which need the kind of command and control you mentioned, need a lot of other things which are longer poles in the tent, as they say.

Mr. **Darden**. Dr. Karas, we appreciate your being here this morning.

[Mr. McCloskey has requested that a copy of Harold Brown's article on SDI be placed on the record.]

[The following information was received for the record:]

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# IS SDI TECHNICALLY FEASIBLE?

The program known as the Strategic Defense Initiative (SDI) includes research on a variety of technologies—many aimed at distinct phases of the ballistic missile flight path. For each phase—boost, post-boost, mid-course and terminal[1]—a defense would require successful surveillance, target acquisition, tracking, guidance of the weapons, and kill mechanisms. Are the objectives of SDI technically feasible?

The answer will depend primarily on what specific objectives strategic defenses ultimately seek to achieve—protection of population, of missile silos, of other military targets. Within that context, the answer will further depend on the capabilities of the technologies and on the potential countermeasures and counter-countermeasures of each side.

This article will assess the prospects for the various defensive technologies for both the near term (10 to 15 years) and the longer term. It will include recommendations on how to proceed with a realistic research and development program. It will also make tentative judgments on the technical feasibility of various SDI objectives, though definitive answers are not yet possible. The political desirability of SDI is a separate question, not addressed here.

Finally, in considering the prospects for the various SDI technologies, it is important to remember how long it takes to move from technological development through full-scale engineering to deployment. That time is governed by the budgetary and legislative process, as well as by the state of technology.

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[1] The boost phase is the period during which the ballistic missile rockets operate to bring it to (or near) its peak velocity. In the post-boost phase the warheads (and decoys) are released from the last stage of the missile. It is followed by the mid-course phase outside of the atmosphere, the lengthiest part of the trajectory. The terminal phase is the period from shortly before reentry into the atmosphere until detonation.

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Harold Brown, President of the California Institute of Technology, 1969–77, and Secretary of Defense, 1977–81, is now Chairman of the Foreign Policy Institute, School of Advanced International Studies of The Johns Hopkins University.

—After the technology is proven out, full-scale engineering development of a moderately complex system will typically take five to eight years (a new ICBM is a good example).
—The course of deployment (unless there is concurrency of development with deployment, which has almost always proven counterproductive) takes five to seven years after completion of engineering development.
—Thus, if proven technology exists now, it will take 10 to 15 years before a new system employing the technology could be substantially deployed.
—If the technology needs to be further developed, even though the phenomena exist and are well understood, the time for that technology development will have to be added to such a period.

## II

What kinds of technologies could be embodied in defenses against ballistic missiles that could begin deployment before or about the year 2000?

Terminal hard point defenses (e.g., defending ICBMs), using hardened ground-based radars and interceptor rockets, would require about ten years between a decision to deploy and having a significant force; the time to completion of deployment would approach 15 years from decision. The necessary technology exists now, and some subsystems have already been partially developed. What would be required would be the design of a new system involving—in sequence—some additional prototype development, full-scale engineering development, production and deployment. Such a system would include an interceptor like the Spartan missile aimed at reentry vehicles (RVs) outside the atmosphere, and another, rather like the Sprint missile, for intercepting RVs that have already entered the atmosphere.

Present designs of both missiles would require the use of nuclear warheads. Alternatively, non-nuclear versions could be developed using terminal homing devices in the interceptor. There is some question about how heavy a conventional warhead (and therefore the interceptor missile) would need to be in order to provide high probability of destroying the incoming RV and missile warhead; it depends on how close to the reentry vehicle the terminal guidance could bring the interceptor. If a non-nuclear interceptor is chosen, this would lengthen by at least a few years the time to a substantial deployed capability.

An additional optical sensor, the Airborne Optical Adjunct (AOA), which would track reentry vehicles by detecting their infrared emissions or viewing them with visible light, could also be included at about the same time as a non-nuclear warhead.[2] Such a capability is feasible technologically and likely to be helpful in discrimination during or shortly before the offensive missile's reentry, but the technology would need some additional development.

Over the next 10 to 15 years it also appears technologically feasible to develop the components of a system using *space-based kinetic-energy weapons*. These chemically propelled rockets would intercept the offensive missile during its boost phase and destroy the target by impact or by detonation of an exploding warhead. The chemical rockets would be similar in nature to air-to-air missiles, but steered with reaction jets rather than aerodynamic surfaces. The targets could be designated to the interceptors by laser or radar tracks, provided by a set of tracking and fire-control satellites orbiting at a higher altitude than the satellites from which the interceptors would be fired. Short-range laser designation of ground or airborne targets exists, but the accuracies required for ICBM tracking would require significant additional technological development, as would imaging and processing the infrared data, and looking close to the horizon.

The interceptors would home onto the target, guided by their own passive observation of the infrared emissions from the target missile or by receiving reflections from the target of radar signals emitted from satellites (semiactive radar homing). Such a system, however, must find a way to direct the killer rocket to the actual ICBM booster rather than to its plume (exhaust), which emits the infrared signal. While presumably this can be done, it will add complexity and offer an opportunity for offense countermeasures. Though the technology for components of kinetic-energy kill and boost-phase intercept systems exists, solution of problems of this sort would require a considerable developmental process.

Several years of additional technical development could significantly decrease the weight of the intercept rocket for a given kill probability. That approach is indicated because the weight determines a significant part of the total system cost. The cost of putting payloads in orbit with either the present shuttle or expendable boosters is thousands of dollars per pound. To reduce those costs to an acceptable level, a new "super" shuttle would probably have to be developed. This would involve a ten-year development process and a delay in deployment of a space-based kinetic-energy system.

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[2] Development or testing of AOA beyond the technology platform stage, as a component of an ABM system, even of a fixed ground-based ABM system, would appear to violate the ABM treaty because the AOA is itself a mobile component.

Missile boosters in the upper atmosphere and in space can be detected, tracked and attacked through the infrared emissions of the missiles' exhaust plumes while their propulsion stages are burning; however, the actual effectiveness of such an approach will depend not only on the technical features of the defense, but on the actions of the offense in employing decoys, adopting countermeasures and suppressing the defensive system itself. For example, modest deliberate fluctuations in booster propulsion ("jinking") could require the kinetic-energy interceptor to make significant changes in its cross-trajectory velocity, and this would involve a large weight penalty for the defense. Fast-burning boosters would effectively negate such a defense system.

Nevertheless, the technology for a space-based boost-phase intercept system of some capability, using kinetic-energy weapons, could be ready for a decision as early as 1990–92 to initiate full-scale engineering development, with a significant deployment able to begin some time between 1995 and 2000. Soon after the year 2000 there could thus be deployed a space-based kinetic-energy kill system along with a high-altitude and low-altitude terminal defense. These would constitute three layers of a possible multilayered defense, the purpose of which would be to compound modest kill probabilities in each defensive layer so as to produce a high overall kill probability.

## III

For the period five to ten years beyond 1995–2000, more elaborate space- and ground-based technologies *may* be feasible, with a corresponding period of deployment beginning some time between 2000 and 2010. Increased uncertainty, however, naturally attaches the further out we look.

Among the less uncertain of these later technologies are *space-based directed-energy weapons* such as neutral particle beams and chemical lasers.

—A *neutral particle beam* (NPB) would be made up of atomic particles, accelerated to a high speed in charged form by electric fields in an accelerator, then steered and pointed by a magnet, and then neutralized so that it will not be deflected by the earth's magnetic field.

—A *chemical laser* uses the energy created by chemical reactions[3] to create a highly focused, intense, highly ordered ("coherent") beam of infrared light, directed by a mirror.

As a measure of their status, both of these technologies could well be used toward the early end of the period 2000–10 for antisatellite purposes, which are less demanding than the antiballistic missile task. Demonstrations of the capability to kill an individual satellite by such means—most likely on cooperative targets—could be made still earlier, but these would not represent an operational military system.

Neutral particle beams are, in their present state of development, much brighter than any existing laser in terms of energy into a given solid (cone) angle. Today they produce particles of energy corresponding to acceleration by a few million volts of electric field (and could in the future be improved to 100 million "electron-volt" energies). Protecting ballistic missiles from such high-energy NPBs would require much heavier shielding than would protection from lasers. During the next 10 or 15 years, however, it is unlikely that NPB technology will be able to put more than ten percent of the primary energy into the particle beam itself. Such low efficiency means that a space-based NPB would probably require a nuclear power source, development of which would delay the possible deployment of a system.

In addition to the usual target acquisition and tracking problems, a defense based on neutral particle beams has several other critical tasks. The magnet necessary to point the beam before its neutralization is likely to be heavy—and expensive—to put into space. The tasks of developing an ion source capable of operation over some minutes and of achieving the necessary pointing accuracy will be difficult. Even more difficult is tracking the beam, since it gives off almost no signal in space. Finally, the system will need to find ways to detect the effect on the target, through nuclear emanations from it, because at the full range of a successful NPB attack, the target would not be physically destroyed. Even where NPBs cannot be used to kill targets, however, they might ultimately prove useful in discriminating among them, because the nuclear emanations from an object hit by an NPB would depend on the object's weight.

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[3] For example, the chemical combination of hydrogen and fluorine. If the population of the resulting excited molecules outnumbers that of the lowest-energy ("ground") state, stimulation of emission of light of the frequency corresponding to the energy difference occurs, resulting in an intense coherent beam.

For chemical lasers several technological problems still need to be solved. One is getting high enough power while maintaining a low enough beam divergence. Another is the very large weight of chemical reactants required for providing the energy. A third is the feasibility of the large optical systems required. There are, however, some promising technologies under development for chemical and other lasers. Among them are: various phase-compensation techniques to improve the quality and stability of the beam; phase-locking separate lasers together to increase the overall brightness; using adaptive optics (rapid adjustment of segments of a mirror), both to compensate for atmospheric dispersion for ground-based lasers and to ease the problems of creating large aperture mirrors for space-based ones; and phased arrays of lasers to increase intensity and to steer them more rapidly through a small angle, so as to move quickly from target to target. But some of these technologies have yet to reach full demonstration of the physical principles involved, and all are still far from being developed.

## IV

Less technologically developed, and therefore more suitable for consideration of full-scale deployment beginning 20–25 years from now, is the use of ground-based *excimer* and *free-electron lasers* (FEL)[4] to be used with mirrors in space as components of a system for boost-phase intercept. Both are now many orders of magnitude away from achieving the intensity necessary for the required lethality, the free-electron laser further away than the excimer laser, at present. But the free-electron laser's device weight is lighter and its efficiency greater (and thus, its fuel weight lighter) than that of the excimer laser.

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[4] Excimer lasers use "excited" (higher-energy) states of molecules including a rare gas (e.g., argon) and a halogen (e.g., iodine). These excited states are quasi-stable, while the unexcited ("ground") states are not populated, because the rare gases are not chemically active in their lowest-energy states. Free-electron lasers use the effect of oscillating electromagnetic fields on electron beams to cause the electrons to emit phase-coherent (laser) radiation.

The FEL might perhaps therefore be deployable in space. But the weights of these lasers and of their energy supplies more probably would require either to be ground based. The laser wavelength for both would allow the beams to penetrate the atmosphere, if the atmospheric distortions problem is solved. Thus both seem more suitable for ground deployment along with mirrors in space. Other problems for the ground-based lasers are the large optics required, both on the ground and for the synchronous-altitude steering mirrors, and obtaining the same high power in each of a long series of repetitive pulses.

These two systems might also be suitable for "active" discrimination—also called "interactive" or "perturbing"—in the mid-course phase of a strategic defense. That is, they could impart energy or momentum to very large numbers of objects in mid-course being tracked by some of the more established technologies already discussed. The resulting changes in the objects being tracked, or in their trajectory, could offer some limited opportunities for discrimination of reentry vehicles from decoys and debris.

Significant technological disagreement exists about the potential of ground-based lasers (free-electron or excimer) versus space-based chemical lasers. Some believe that the smaller amount and lesser complexity of hardware required to be put in space will bring the time for availability of these ground-based lasers as close or closer than the time actually required for those entirely space-based.

Chemical lasers are more proven technologically than excimer or free-electron lasers, but many experts have dismissed their potential use because of the difficulties in designing an effective system. Chemical lasers (space-based because their wavelengths will not penetrate the atmosphere) could be of some use against ballistic missiles now deployed. They could well be severely inadequate, however, against the offensive systems (with, for example, fast-burn missiles and other countermeasures) that could be in place during the first decade of the next century, when a significant defensive laser deployment could be made. Surely such countermeasures would be put in place if defense lasers were deployed. And in light of the large weight of chemical fuel that would have to be deployed in space, the chemical laser system at present seems to fall into the category of technically feasible but ineffective as a system. New optical developments such as phased arrays and phase conjugation are now being investigated, however. These might be able to improve the brightness and stability of chemical lasers—and increase their lethal range—to the point where they would have some systems effectiveness even against a responsive threat.

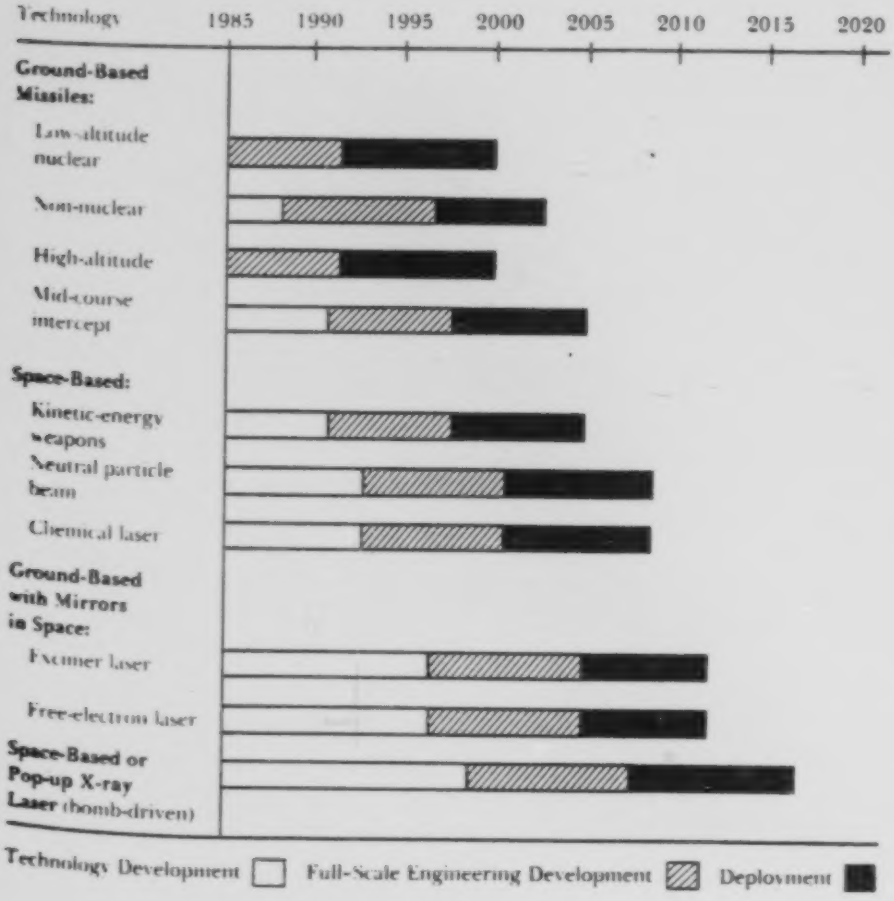
*X-ray lasers* powered by nuclear explosions are still further off than the other types of lasers, although they seem to offer some interesting distant possibilities. X-ray lasers would have wider beam angles and higher power per unit solid angle than optical ones. This would make them suitable for destroying clouds of objects or for actively discriminating heavy objects among them, and thus effective against such countermeasures as balloons and decoys. Proof of the most basic principle has been established, in that bomb-driven X-ray lasing has been demonstrated to be possible. But there is doubt as to what intensity has been achieved; it is in any event far less than necessary for use in active discrimination, let alone target kill. Demonstration of the physics of a possible weapon is at least five (more likely ten) years off. Weaponization would involve another five or more years, and only thereafter could its incorporation into a full-scale engineering development of a defensive system begin.

*Rail guns*, which accelerate objects to very high speed electromagnetically, may also have promise. But they are almost as far off as X-ray lasers. Multi-kilogram payloads would need to be accelerated to speeds above 15 kilometers per second, and a system (and power source) would need to be designed that could be used for multiple shots. New guidance and propulsion systems would also have to be engineered to survive such accelerations and to do the necessary terminal homing.

While many uncertainties exist as to future laser technologies for strategic defense, all laser systems would be vulnerable to other lasers. In general, the rules of the competition are that ground-based lasers will defeat space-based ones, larger ones will defeat smaller ones, and bomb-driven X-ray lasers looking up though the fringes of the atmosphere will defeat the same sort of X-ray lasers looking down into the fringes of the atmosphere. Vulnerabilities will also differ as between ground-based and space-based lasers. The former would have the weapons—or at least their energy source—on the ground, and presumably would include mirrors stored or unfolded in or popped up into space for the purpose of steering the laser beams.

As to time scale, when one is talking about time scales for deployment 25 or more years from now, corresponding to technologies whose full demonstration is more than ten years away, one really cannot know what the time scale will be to reach substantial deployment. The accompanying chart summarizes the time scales for these various systems. For the space-based systems, the pop-up systems and those with mirrors in space, lengthy technology development periods will be required. Depending on how that development is carried out, it may be possible to defer collision with the provisions of the ABM treaty until early in the process of full-scale engineering development. The calendar times differ for each technology, as shown in Figure 1.

FIGURE 1



## V

A successful strategic defense would require not only kill mechanics but also a *battle management system* involving sophisticated *command, control and communications* ($C^3$). Estimates for the total number of lines of code of software required range from 10 million to 100 million. A measure of the effort involved can be derived by using the standard figure of $50 a line. Thus, the software costs could range from $500 million to $5 billion. The raw cost of such a system is therefore less important than the feasibility and methods of finding and correcting errors in it.

One problem would be with errors in the codes themselves. While this would not be trivial, it could be dealt with in part through automated software production and through artificial intelligence. The latter, though still mostly in the conceptual stage, nevertheless has real capabilities in terms of expert systems, and can be expected to produce real advances within the next ten years. The most fundamental problems for battle management and $C^3$ are: the establishment of appropriate rules of engagement; the probability of conceptual as well as mechanical error in the creation of the software, and the possibility of redundancy to compensate for it; the need to change portions of the software as new elements are introduced into the system without having the changes compromise the working of the rest of the software; and, most of all, the ability to check out the system, so as to make sure there are no conceptual errors in the software in such matters as handing over tracks of the offensive missiles, transferring automated decisions from one node of the system to another, avoiding loops in the logical sequence, and so forth.

How could such capabilities be tested? Can on-orbit testing be used? Such problems are just beginning to be addressed, and it will take a long time before conclusions can be drawn even as to what the state of this particular technology is compared with what is needed.

## VI

In terms of future defensive technologies, what potential defense systems are technically feasible?

It is technologically feasible to create a *terminal defense* overlay of hard ICBM silos, deployed so that the missiles are moved among multiple silos and so that their position at any one time is unknown to the attacker. Such a defense overlay can, by preferential defense—that is, defending only the occupied silos—provide a cost-exchange ratio favorable to the defense because the attacker must attack all silos. The same is probably true of defense of moderately hardened mobile missile systems by a terminal defense of corresponding mobility and hardness. In the case of hard-silo defense, a single layer of defense by endoatmospheric ground-based interceptors would suffice. For mobile hardened missiles, a two-tier ground-based system would probably be needed.

Modified ground-based defenses using similar technologies could protect some other military targets, for example command and control centers. The exchange ratio at the margin will vary widely, however, among classes of such targets according to their nature (hardness, area and mobility), their number and their cost. Such defenses could also be deployed for a thin protection of some urban-industrial areas, though they must be recognized as protecting such targets, if at all, only against attacks that are both limited in size and not responsive (i.e., not modified to take account of the defenses). Terminal defenses for these categories would use two-tier ground-based interceptors, and until the early 21st century would need to carry nuclear warheads in at least the exoatmospheric long-range tier. The defenses would be accompanied by space-based early warning and tracking sensors, and by airborne optical sensors to aid in the discrimination task during the terminal phase.

Advanced versions of infrared sensors deployed near or above geosynchronous orbit (an altitude of 20,000 miles) will be needed for attack warning and assessment in any defensive system, even if no boost-phase intercept is attempted. Infrared or other sensors in lower orbits (at altitudes of hundreds of miles) would also be useful to all layers of a ballistic missile defense system for tracking and discrimination. But the sensors must be able to survive. This suggests that they be provided with some self-defense, which in turn could be the first step toward boost-phase intercept.

As to weapons, kinetic-energy rockets based in space are technologically feasible. But an ICBM using a fast-burn booster clearly defeats them, and space-based defenses are vulnerable to defense suppression. Estimates of the exchange ratio for a *boost-phase intercept* defense layer based on kinetic-energy kill range from as low as two to one adverse to the defense at the margin (assuming unresponsive offensive threats and including sunk costs for the offense) to more realistic estimates, assuming responsive offenses, of five or ten to one. Defense suppression would probably further shift the ratio in favor of the offense.

Space-based chemical lasers seem feasible in technological terms but more questionable in practical systems terms. Though likely to be faster in response than kinetic-energy weapons, they still will not be a match for fast-burn boosters of offensive missiles. They will, moreover, be vulnerable to defense suppression systems based on other space-based lasers, and also vulnerable to ground-based lasers and direct-ascent antisatellite weapons. Ground-based lasers, whether free-electron or excimer lasers, are interesting future technologies and may be more effective than chemical lasers, but it is too soon to know.

It should be noted that even though fast-burn missiles could thwart a boost-phase intercept, this still leaves the possibility of a *post-boost tier* or layer in an SDI system. The deployment by the offense of warheads and decoys cannot occur until later in the trajectory than the boost phase, at a higher altitude in order to avoid atmospheric drag. But the technology for post-boost intercept capabilities is likely to be difficult to achieve, because it will require electronic examination of images (pictures), using ordinary or infrared light, to distinguish among various components: the burned-out upper stage of the missile, the post-boost vehicle, and the various objects released from it. These requirements, the countermeasures, and the potential technological capabilities for a post-boost layer of defense are just beginning to be considered.

Which technologies would be useful in the next tier, in *mid-course intercept*, is still less understood. Presumably the defense would want to use the same kill methods (kinetic-energy and directed-energy weapons) for intercepts as in the other tiers. This has the advantage of allowing some of the absentee satellites[5] to come into play because of the longer time period involved in mid-course flight of a missile. Discrimination among possibly colossal numbers of objects would, however, be a daunting problem. There are ideas about how to address it,

[5] Satellites in nonsynchronous orbit trace out a path over the earth whose pattern and timing depends on their altitude and velocity. Absentee satellites are those whose position in their orbits, at the time when the attacking missiles are launched, puts them over parts of the earth that are distant from the offensive launch sites.

but no confidence in any of them; that is why there is a drive toward consideration of "active" discrimination, which would impart energy to the objects in the threat cloud in order to be able to distinguish among them by observing the effect on their behavior. Thus, mid-course intercept is unlikely to play any role in a deployed system until well after the turn of the century.

Through all of these considerations is entwined a serious problem for space-based ABMS: however effective space-based systems may be against ballistic missiles, they would appear to be more effective in suppressing defenses. And direct-ascent antisatellite systems or ground-based lasers may be still more effective than space-based systems in this latter role.

In sum, given the state of present and foreseeable technology, a boost-phase or post-boost phase intercept tier is not a realistic prospect in the face of likely offensive countermeasures and the vulnerability of those tiers to defense suppression. It will also exhibit unfavorable relative marginal costs as a contributor to defense of population at any reasonably high level of protection. These judgments apply to any system beginning deployment at least for the next 20 years, and probably considerably beyond then.

There are interesting new technologies, however, that leave open the possibility that our estimates of the offense-defense balance might change after that time, especially if some of these technologies prove to have some mid-course discrimination and intercept capability, as well as some boost-phase effectiveness. Such a shift is very unlikely, but strategic thinking should include the possibility that it might take place in terms of deployed systems some decades into the next century.

## VII

What would a defense system look like if the priorities of the Reagan Administration's SDI program (boost-phase intercept and population defense) were to be combined with the technologies that will be available and a reasonable development program leading to deployment around the year 2000?

It would be likely to have space-based components. It would perhaps include, for example: a dozen satellites at one-half to two times geosynchronous altitude to carry out boost surveillance and tracking; some tens of satellites at perhaps one thousand kilometers altitude to carry out surveillance, tracking and fire control for the attack of boosters, post-boost vehicles, and objects in the mid-course part of the trajectory, using infrared detection (short wavelength for boost, long wavelength for mid-course) and laser designation, and possibly some semiactive radar or laser radar tracking; some thousands of satellites, at altitudes of a few hundred kilometers, whose main purpose would be to carry kinetic-kill vehicles, of which there would be a total in the tens of thousands for use as actual defensive weapons.

In parallel, terminal defenses would also be deployed. These would include terminal radars and an airborne set of optical and infrared detectors. There would be some thousands each of exoatmospheric and endoatmospheric interceptors, deployed around missile (ICBM) silos, other military targets and major urban-industrial areas. Some of the endoatmospheric interceptors might even reach out into the later parts of mid-course flight. To moderate the costs of putting into orbit the space-borne component of the system, a new and advanced shuttle would be developed and put in use beginning about 1997.

A supplementary deployment or second phase could be expected to commence eight to ten years later, thus beginning somewhere between 2005 and 2010, and taking another five to seven years to complete deployment. During that phase there would be added satellites carrying chemical lasers for killing offensive targets, and lasers or neutral particle beams for discriminating in mid-course as well. Alternatively, ground-based lasers with mirrors in orbit would be deployed, perhaps as early or perhaps three to five years later still. This second phase carries us into the realm of hypothetical technologies and cloudy crystal balls; X-ray lasers and electromagnetic rail guns lie still deeper in those realms.

Whatever the system architectures, there must be consideration of the possibility—and the effect—of catastrophic failure of one layer of a multitiered defense on the subsequent layers. In both the quantity of hardware and the nature of the software (that is, the built-in operational procedures), the systems must therefore be designed to provide a way to avoid catastrophic failure of a later layer (and thus overall failure) because of a poorer-than-expected performance of earlier layers. The simple multiplication of attrition factors in a series of layers, the number of which is sometimes rather arbitrarily assumed, carries an inherent assumption of its own. The assumption is that the operation of each layer's sensors, tracking, kill mechanisms and effectiveness is completely independent of the nature, physical components and effectiveness of all the previous tiers. The architecture of the entire system has to be such as to assure that this would in fact be the case to the maximum possible extent; also, to the extent it is not, to assure that the system degrades "gracefully." This will not be an easy or inexpensive task.

## VIII

What would constitute an appropriate research and development program?

Though existing technology and system concepts for terminal defense can provide an effective defense of hard ICBM silos deployed in a multiple protective shelter mode, more advanced technologies—optical trackers, more accurate interceptors and lower interceptor yields—would increase the system's cost-effectiveness. For improving the contribution of terminal defense to protection of urban-industrial areas and, possibly, of military targets other than missile silos, the technology associated with non-nuclear kill and with terminal discrimination should be pursued. These would include greater tracking accuracy, homing warheads and the airborne orbiting adjunct. Deployment of a prototype developmental version of a terminal defense complex at a test range (Kwajalein) would be extremely valuable, and consistent with the ABM treaty.

Early warning and attack assessment systems should be further developed, including those based on detection of the infrared signal from missiles in a boost phase. To this end, improvements in the present Satellite Early Warning System should be carried out. Infrared, optical and radar tracking of objects in space from distances of up to about a thousand miles will also be useful for any defensive system. The corresponding R&D should therefore be vigorously pursued.

Because kinetic-energy weapons and conventional chemical lasers will be defeated by, or suffer a severe cost-exchange disadvantage from, offensive countermeasures and defense suppression, the R&D program should concentrate on the more advanced kill mechanisms and active discrimination methods that are further off in time. Such an approach, however, is legitimately subject to the criticism that "the best is the enemy of the good." Moreover, the effectiveness of future technologies is easily overestimated simply because less is known about them.

If one judges that the good is not good enough, then it is appropriate to work on something better (and therefore usually further away in time). This conclusion depends, however, on a judgment that successful development of such an advanced technology has a good chance to improve the defense's position in the balance between defensive measures and countermeasures. This last criterion may turn out not to be met even by the more advanced technologies for active discrimination and kill. For example, it continues to appear that everything that works well as a defense also works somewhat better as a defense suppressor. But the balance between offense and defense seems even less likely to shift in favor of the defense as a result of the nearer-term technologies than as a result of the more advanced ones. Thus, it is appropriate to increase the R&D emphasis on such programs as:

—optical technology, including, *inter alia*, the following elements: adaptive optics, i.e., adjusting the wave-front shape to compensate for distortions in the laser source and in the atmosphere; locking the phase of separate lasers together so their amplitudes add, greatly increasing the brightness; using one laser to drive another; phased-array lasers (for improving intensity, steering capability and atmospheric compensation);

—combining lasers and particle beams as a way of focusing the beam better;

—excimer and (especially) free-electron lasers, and the kill mechanisms based on those technologies; application of advanced optical technologies to chemical lasers;

—ground basing of lasers, and pop-up mirrors (which should be less vulnerable) or mirrors that unfold and that can be more easily deployed to make them less vulnerable as targets;

—verification technology for computer programs, fault tolerance, expert systems and automatic programming—in order to improve confidence in software;

—active and perturbing discrimination and other mid-course signature work (since the mid-course part of the flight gives the defense a longer time to act, *if* discriminants can be found for use by the defense); and

—survivability of space-based defensive components, especially sensors.

Bomb-driven X-ray lasers could be very effective because they could achieve very high brightness and medium beam width. But they are at such an early stage that the program, while deserving support, should be confined to demonstration of those two features. Rail guns may be useful but only if they meet very ambitious goals for speed, mass and multi-shot capability. Even then, conventional rockets accelerated to equally high speeds (and with correspondingly heavy propellant weight) may be competitive with rail guns; but neither is likely to be cost-effective.

Demonstrating the technology to achieve the above goals for X-ray lasers and rail guns should precede any consideration of a systems effort for them.

## IX

In the light of the considerations set forth, what should be the emphasis of the SDI program? What should be the balance among systems design, component development, experimental demonstrations, and technology? What should be deemphasized or eliminated? These questions become more acute in the light of the substantial reductions in the funding of the research and development program from the proposals formulated in the Fletcher Committee Report of 1983.[6] Though congressionally approved funding is likely to exceed $2.5 billion in the current fiscal year, the scope of the program is so ambitious that schedules set only a year ago for systems decisions appear to be slipping, and some difficult choices about priorities will have to be made.

It would seem appropriate to emphasize technology that still needs to be proven and developed, rather than "spectacular" demonstrations—though at some point demonstrations would be needed to test the technology. Some technologies are sufficiently demonstrated, and the corresponding systems concepts sufficiently clear, so that engineering development could begin on them relatively soon. But doing so would make sense only after a decision as to the detailed nature and function of the defensive system.

1. Work is indicated to define the design of a ground-based terminal defense system, which could stand by itself or be a layer of a multilayer strategic defense system. This would involve updating the Spartan and Sprint missiles, and beginning

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[6] The work of this committee, headed by Dr. James C. Fletcher, was published in the unclassified report, "Strategic Defense Initiative: Defensive Technology Study," U.S. Department of Defense, March 1984.

work on the design of a non-nuclear interceptor. This system should have the capability of being deployed as a defense of the U.S. ICBM force, as well as serving as a component of a population defense if that should ever prove feasible.

Initiation of full-scale engineering development for such terminal defenses should be deferred for several years. This would allow two prior determinations. One is the technical and military feasibility (and political acceptability) of less vulnerable modes of ICBM deployment. The second is whether mutual reductions in the size of strategic offensive forces can be negotiated, to reduce the need for active defense of ICBMs. An appropriate schedule would be to get the technology ready for a possible 1988 initiation of full-scale engineering development, and a start of deployment in the 1993 time frame if such a decision is taken.

2. Space-based kinetic-energy weapons appear unpromising in the light of the almost certain offensive countermeasures, and therefore should be deemphasized, even though such a system is the only space-based one that could be reasonably well specified today. By the same logic, it would make sense to delay a decision on detailed specification of and initiation of full-scale engineering development on any boost-phase intercept system until 1994 or 1995. By that time enough ought to be known about the technology of the various directed-energy weapons to allow a more informed choice among them.

3. A full-scale technology program (phasing into development as particular technologies reach that stage) on boost-phase surveillance, mid-course surveillance and tracking is fully warranted. Boost-phase surveillance capabilities will augment early warning of attack; mid-course surveillance and tracking will augment attack assessment capabilities. These functions are justified even in the absence of a decision to proceed with active defense of population. Like the terminal defense development activities, they are consistent with restrictive interpretations of the ABM treaty. But they would also constitute the eyes of a strategic defense of population or of military forces against ballistic missile attack, should such a defense be decided upon.

4. A full program on adaptive optics, phase compensation and phase conjugation devices, phased-array lasers and related optical technology should be emphasized strongly, since obtaining the brightness and beam accuracies required for effective-

ness even in the absence of offensive countermeasures depends strongly on these technologies.

5. The electromagnetic rail gun, bomb-driven X-ray laser, and (probably) neutral particle beam programs all belong in the preliminary technology stage. If they work they would be useful in specific functional areas of a strategic defense system, but they are in too preliminary a stage to justify putting them in the component development category.

6. The directed-energy weapons segment of the program should be tilted toward the excimer and (especially) free-electron lasers, with emphasis on ground basing the energy sources and consideration of space-based mirrors as the pointing mechanism. Work on space-based chemical lasers should emphasize ways of making them brighter—such as phased arrays—within the limitations imposed by space basing; it is probably too early to abandon chemical lasers completely.

This orientation of the program would, as a separate matter, delay conflict with the ABM treaty while permitting rapid development and even preliminary testing of technology. It corresponds to an acceptance of the judgment that the program dates are ambitious even for the more developed (and less promising) technologies, and concentrates on the less developed but more promising ones.

That approach would defer until after 1995 the decision on full-scale engineering development for the directed-energy boost-phase intercept segment of the program that could involve space-based components generating or transmitting very high energy densities. Such a schedule, however, might prompt concerns that it was so far in the future as to undermine congressional and public support for the program. But that factor works both ways. Though there is real public support for strategic defense, both the expert and congressional communities are doubtful about the vision of protecting populations from a nuclear attack by means other than deterrence through the threat of retaliation. They are also concerned about the potential negative effects of SDI on arms control. Moreover, even those defense tasks and system components that look most promising are subject to serious policy objections regarding their deployment or testing. Thus a sign of willingness to pursue a more modest track, with long-term goals, and more care about arms control, would probably favorably influence a decisive segment of congressional votes on program funding.

To sum up, the near-term prospects for ballistic missile defense capabilities are reasonably well known. Technically, they appear cost-effective for defense of some kinds of strategic retaliatory forces. For defense of populations against a responsive threat, they look poor through the year 2010 and beyond. The prognosis for the longer term for this latter objective in the contest between defense and offense is less certain. It still looks questionable, at best, for the defense, because of some fundamental problems of geometry and geography, and the physics of offensive countermeasures and defense suppression in their contest with defense.

Mr. Courter submitted the following questions to the witness to be answered for the record:

Mr. Courter: Why does OTA feel that BMD research is necessary, when it is apparent that OTA has grave questions about BMD deployment programs.

Dr. Karas: We believe that important questions should be asked and satisfactorily answered before any kind of weapons deployment decision.

As our report indicates, while there is general agreement among those in the United States concerned with BMD that BMD research should be done, there are at least three different views about the chief purposes the U.S. BMD research program should have.

First, there are some who are already convinced that the earliest possible BMD deployment is desirable and that a major thrust of our research should be toward the full-scale engineering development and deployment of currently available BMD technologies.

Second, others hope that deployment of BMD will prove worthwhile, but believe that further research is necessary to find out whether deployment of effective defenses will indeed be feasible and cost-effective. This is the Administration position.

Third, still others doubt that BMD deployment is likely to prove desirable in the foreseeable future, but agree that BMD research is important:

a) to explore the potential of advanced technologies;

b) to hedge against technological surprise--i.e. to assure ourselves that the Soviets are unlikely to succeed in developing weapons for which we have no response;

c) to attempt to deter a possible Soviet decision to deploy nationwide ballistic missile defenses in abrogation of the ABM Treaty by showing readiness to respond with offensive countermeasures, BMD deployments, or both;

d) to be prepared, if necessary, to respond to Soviet abrogation of the BMD Treaty with U.S. offensive countermeasures, BMD deployments, or both.

Mr. Courter: OTA says on page three of the statement that the present BMD program is "technology limited." What is OTA's opinion of the proposition that the program is also "funding limited," due to Congressional unwillingness to approve SDI budget requests as submitted?

Dr. Karas: Our statement refers to the "Strategic Defense Initiative Program as proposed by the Administration" as a "technology-limited" program. Congressional reductions of the proposed budgets would, logically, lead to a "funding-limited" program. In recent testimony, General Abrahamson has indicated that he would be more actively pursuing some technologies were the funds he requested available.

Mr. Courter: Does OTA feel that the apparent SDIO movement toward early deployment technologies is a result of technology advances, funding constraints, or both?

Dr. Karas: Recent statements by SDIO officials about unexpectedly rapid progress in some technology areas led us to the parenthetical suggestion in our written statement that the SDIO might be contemplating earlier BMD deployments than originally forecast. In recent testimony, however, General Abrahamson has reaffirmed that the SDI seeks information that would allow a decision in the early 1990s about whether to proceed with BMD development and deployment. We conclude, therefore, that the technical progress referred to might permit weaponization of some technologies earlier than previously forecast for those particular technologies, but that an earlier decision about deployment of any BMD system is not contemplated.

General Abrahamson has also testified that part of his responsibility is to maintain the option to respond to a Soviet BMD "breakout" with a U.S. BMD deployment of some kind. But maintaining that option for an early deployment is not the same as advocating early deployment.

Mr. Courter: What is OTA's opinion about the configuration of the most credible SDI system available for early deployment (early 1990s)?

Dr. Karas: It is the stated purpose of the SDI program to enable a decision about the feasibility of deployment by the early 1990s, not actually to bring about deployment by that time. Therefore, there is unlikely to be a credible SDI system available for deployment by that time. However, it may be asked what kind of configuration a ballistic missile defense system might have if a decision were made now to deploy one in the early 1990s.

The earliest feasible BMD system would use technology which is mature or becoming mature today. The weapons in such a system would almost certainly consist of chemical rockets which would most likely be land-based. These could kill either by direct impact, or, using old technology, by means of nuclear warheads.

Land-based interceptors could be either designied to intercept missile re-entry vehicles either within or outside the atmosphere. Land-based endoatmospheric systems would be useful for defending hard targets such as missile silos, but not for defending soft targets such as cities, because nuclear explosions from intercepted warheads near the earth's surface could occur in a large fraction of cases. Long range exoatmospheric interceptors could, in principle, defend soft targets, but a system that used them would have to be able to discriminate decoys from targets in space, a challenging task unlikely to be accomplished within this time frame.

Radars for such a system would probably include many expendable, shielded units. There is also the possibility of using airborne infrared detectors to provide a more survivable acquisition and tracking system and one that uses a different range of the electromagnetic spectrum.

At least some of these weapons and sensors might be available for initial deployment by the early 1990s, but it would probably require several years to achieve full operational capability. The number of interceptors required could reach into the tens of thousands.

For space-based components, current discussion for the earliest possible deployment now centers around the concept of many (thousands) of space platforms, each containing many (possibly hundreds) of small kinetic kill rockets. Even if such systems were to be ready for deployment by the early 1990s, which is extremely unlikely, it would take years to finish the deployment in space. More exotic systems, such as ground-based lasers with orbiting relay mirrors, if they become feasible and affordable, are farther off in the future.

Mr. Courter: On page four of the statement concern is expressed about our tests and demonstrations which might have an eroding effect on the ABM Treaty. What, in OTA's opinion, has been the effect of Soviet ABM activities on the viability of the ABM Treaty?

Dr. Karas: Two kinds of Soviet ABM activities can have an erosive effect on the viability of the ABM Treaty.

One such kind of activity is the testing and deployment of weapons components or systems which arguably are within the letter of the Treaty, but which may be seen as leading to a "creep out" from the Treaty because they might be utilized against strategic missiles. As National Intelligence Council officers testified to Congress in 1985 in referring to the Soviet SA-X-12 surface-to-air missile, "Its technical capabilities bring to the forefront the problem that improving technology is blurring the distinction between air defense and ABM systems. This problem will be further complicated as newer, more complex air defense missile systems are developed."

Potential U.S. responses to such activities might include: a) formal or informal attempts to tighten Treaty restrictions to prevent such "creep out"; b) maintenance of offensive penetration capabilities to meet the threat; c) maintenance of readiness to deploy systems of comparable effectiveness in the event that the Soviets are believed to have achieved significant BMD capabilities; d) comparable "creep out" developments; d) withdrawal from the Treaty. Soviet exploitation of technical shortcomings or ambiguities in the Treaty language, then, could ultimately led to the Treaty's abrogation.

A second type of Soviet ABM activity is of more immediate concern: the clear violation of Treaty terms. The Administration has judged that the ballistic missile early warning radar under construction near Krasnoyarsk constitutes such a violation. Such violations of particular provisions of the Treaty may threaten the viability of the Treaty in three ways: first, they may so endanger U.S. national security as to lead to a U.S. decision to respond by withdrawing from the Treaty; second, they might lead to a U.S. decision to carry out "comparable" violations; third, the bad faith they show may undermine U.S. political support for adhering to the Treaty.

The radar at Krasnoyarsk appears to threaten the viability of the Treaty most strongly in the third way. That is, it is not in itself a substantial step toward an effective nationwide ABM system for the Soviet Union. Officers of the National Intelligence Council reported to Congress in 1985:

> By the end of the decade, when a new network of large phased-array radars--including the Krasnoyarsk radar--is expected to be fully operational, the Soviets will have a much improved capability for ballistic missile early warning, attack assessment, and accurate target tracking.
>
> These radars will be technically capable of providing battle management support to a widespread ABM system, but there are uncertainties about whether the Soviets would rely on these radars to support a widespread ABM deployment...Because such radars are fixed, and they are key nodes for an ABM for an ABM system's capability, there will always be an issue of whether an ABM system is worth having which depends to a great extent on a few, potentially quite vulnerable facilities.

Whatever the ultimate military utility of the Soviet Krasnoyarsk radar--given its location, orientation, and probable capabilities--violates the terms of the ABM Treaty and has lead to grave concerns in this country about the viability of that Treaty.

Mr. Courter: Is it OTA's opinion that the Soviet Union would have to formally withdraw from the ABM Treaty in order to deploy an effective nationwide ABM system? Would not such a system be simply a logical extension of their activities to date?

Dr. Karas: The ABM Treaty only permits the deployment of up to 100 interceptors at one location. A nationwide system (which would require thousands of interceptors) is banned. Establishment of an effective nationwide system, therefore, would violate the Treaty in an obvious way, whether or not the Soviets were formally to withdraw.

Using mobile, rapidly assemblable (say, on the order of several months) radars and constructing and deploying thousands of interceptors, the deployment of some sort of nationwide defense could be accomplished within several years. According to testimony by Lawrence K. Gershwin of the National Intelligence Council before a joint session of the Senate Defense

Appropriations Subcommittee and the Senate Subcommittee on Strategic and Theater Nuclear Forces (June 26, 1985), such a system could

> ...strengthen the defenses at Moscow and cover key targets in the western U.S.S.R. and...extend protection to key targets east of the Urals by the early 1990's.

The construction of these interceptor launch sites would be an obvious treaty violation which would take years to accomplish, and would constitute a clear break with their activities up to now. Such a land-based nationwide system would be subject to serious, if not catastrophic, disruption by nuclear precursor explosions and, further, could be relatively easily overwhelmed by penetration aids. Therefore the effectiveness of such a system would be questionable. However, it would require a greater number of warheads and a greater effort to assure a high degree of success for a U.S. attack than would be the case in its absence. An extended discussion of how one might define the effectiveness of a ballistic missile defense system can be found in Chapter 5 or our BMD report.

Mr. Courter: What, in OTA's opinion, would constitute effective "supplementary protection" in the ASAT arms control area?

Dr. Karas: One of the conclusions of our report on anti-satellite weapons was:

"Arms control provisions might substitute for passive and active countermeasures in reducing the threat posed by ASAT weapons, but arms control would be more effective if combined with countermeasures."

U.S. satellites can be protected either by increasing their survivability or by reducing the threat posed by Soviet ASAT weapons. Passive or active countermeasures are designed to do the former while arms control provisions are designed to do the latter. In considering the advantages and disadvantages of ASAT arms control, ASAT development, and countermeasures, it is important to consider them in packages. A combination of arms control provisions and passive countermeasures, for example, or of passive countermeasures and active countermeasures, could provide greater security than each component of such a package might provide alone.

For this reason, OTA's report examined seven international legal regimes and their corresponding military postures. Each of these regimes is intended to facilitate assessment of the effectiveness and desirability of different combinations of ASAT and BMD technology development, satellite survivability, and arms control.

The OTA report on anti-satellite weapons also concluded:

"Foreseeable passive or active countermeasures may be inadequate to guarantee the survival of large military satellites attacked by advanced ASAT weapons."

For example, it might be uneconomical to rely on passive measures to protect large and expensive satellites from a powerful neutral particle beam weapon. Active measures -- such as "shoot-back" -- could provide protection against some ASAT weapons but not against weapons such as space mines or single-pulse lasers which could destroy satellites instantly and without warning. On the other hand, it might not be economical to attack satellite systems composed of many small, cheap satellites -- and possibly decoys as well -- with expensive ASAT weapons.

Mr. Courter: What unilateral measures could we take to protect our military space assets?

Dr. Karas: There are at least four significant ways to unilaterally protect our military space assets:

1) *Passive Countermeasures:* Passive countermeasures such as hiding, deception (use of decoys), evasion (maneuvering), hardening (making satellites more durable), and proliferation (adding more satellites) all offer significant protection from the current and perhaps future Soviet ASAT weapons. Decoys would probably be effective against a wide variety of ASAT weapons and will be particularly economical for the protection of small

satellites capable of being imitated by small, cheap decoys. Combinations of these passive responses -- e.g., decoys for "dark" spare satellites -- could offer even greater protection than individual measures alone.

2) *Active Countermeasures:* Active countermeasures may be destructive or nondestructive. Destructive countermeasures could include giving satellites a self-defense capability or providing critical satellites with an escort defense. Nondestructive countermeasures might include electronic countermeasures and electro-optical countermeasures such as jamming. Attacking Soviet ASAT control facilities is also a potential -- though dangerous -- active countermeasure.

3) *Deterrence:* The Soviets might be deterred from attacking U.S. satellites if the United states declared its willingness to retaliate for attacks on U.S. space assets. Such retaliation could be against Soviet space assets, in which case the United States would need a capable ASAT weapon, or it could be against Soviet terrestrial assets. The former alternative assumes that the Soviets value the preservation of their satellites at least as highly as they value the destruction of U.S. satellites. The latter alternative, of course, carries a greater risk of uncontrolled escalation if deterrence should fail.

4) *Keep-Out Zones:* The United States could declare and defend protective zones around critical satellites. Defended keep-out zones could offer significant protection against current ASAT weapons for some satellites.

Mr. Courter: Would there be any value in the U.S. and her Allies deploying an effective defense (either conventional or SDI-related) against air breathing threats like cruise missiles and manned bombers? What is the explanation for the extremely robust Soviet air defense system?

Dr. Karas: The value of even an effective U.S. defense against the Soviet air-breathing threat is probably limited as long as the threat remains relatively small compared to the thousands of nuclear weapons the Soviets are able to deliver with intercontinental and sea-based ballistic ballistic missiles. On the other hand, strategic defenses intended to substantially reduce the damage the Soviets could inflict on U.S. territory would have to include both effective ballistic missile defense and effective bomber/cruise missile defense.

Besides the declining relative importance of the bomber threat in the 1960s, another reason the United States decided not to upgrade its air defense system was that the system itself would probably be vulnerable to Soviet missile attack. If we could develop highly effective ballistic missile defenses, air defenses might at least become more survivable. Just how effective they could be against advanced air-breathing vehicles is another question, which OTA has not addressed.

The value of effective air defenses for U.S. allies is a somewhat more complex question. Where Soviet aircraft and cruise missiles bearing conventional or nuclear weapons had substantial military missions which could not be performed by ballistic missiles, even partial defense against air-breathing delivery vehicles might affect the outcome of a military conflict, particularly a conventional one.

The Soviet air defense system could more accurately be described as "expensive" than as "robust." The explanation for the Soviet investment in air defense is not entirely clear. Unlike the United States, but like our European and Asian allies, the Soviet Union faces potential theaters of war near its own borders, where the tactical aircraft of many nations might play a significant military role. This difference in geography might partially explain the Soviet emphasis on air defense. Another possible explanation is historical momentum: when the Soviets began building their air defense system, bombers were the only U.S. strategic nuclear delivery vehicles. Having a dedicated air defense military service may have made it more difficult for the Soviets to adapt to changes in the threat they face. It might also be noted, however, that air-breathing weapons form a substantially larger part of the strategic threat the Soviets face than is the case for the United States.

There seems to be little doubt in the United States that, despite the extensive Soviet air defense system, our air-breathing delivery vehicles will continue to be able to accomplish their missions for the foreseeable future. National Intelligence Council officers estimated in 1985 that the the Soviet air defense system "...while it will improve in capability from a lot of new elements being deployed...against the large-scale combined attack of several U.S. penetration elements...[it] will still not be able to prevent large-scale damage. It will do better protecting certain kinds of key targets, but that is not an absolute statement, it is a relative statement."

Projected U.S. investments in B-1B bombers, the Advanced Technology Bomber, advanced air-launched cruise missiles, sea-launched land-attack cruise missiles, and ground-launched cruise missiles appear to confirm that DoD officials share the judgement that U.S. air-breathing vehicles will be able to penetrate Soviet defenses for the foreseeable future.

The Soviets, however, may not agree with the U.S. assessment of U.S. capabilities. Or they may believe that stopping even a relatively modest percentage of U.S. nuclear weapons is worthwhile.

Mr. Courter: On page ten of the statement it is said that the Soviets are better prepared at this point to deploy a nationwide BMD system. Does OTA think that such a system will be deployed? What would be the nature of such a system? How effective would it be?

Dr. Karas: OTA has not made an independent assessment of Soviet BMD deployment capabilities, but we have found no reason to disagree with the National Intelligence Council estimate as reported to Congress in 1985:

> ...The Soviets have the major components for an ABM system that could be used for widespread ABM deployments well in excess of ABM Treaty limits.
>
> The components include radars, an above-ground launcher, and the high acceleration missile that will be deployed around Moscow. The potential exists for the production lines associated with the upgrade of the Moscow ABM system to be used to support a wide-spread deployment.
>
> We judge they could undertake rapidly paced ABM deployments to strengthen the defenses at Moscow and cover key targets in the western U.S.S.R. and to extend protection to key targets east of the Urals, by the early 1990's.
>
> In contemplating such a deployment, however, the Soviets will have to weigh the military advantages they would see in such defenses against the disadvantages of such a move, particularly the responses by the United States and its allies.
>
> ...We have evaluated that by the early 1990's, based on our understanding

of where the Soviets are, they could have in place fairly large ABM deployment, but that is not a prediction that it is in fact what is taking place.

The National Intelligence Council report did not assess how effective such a deployment might be. At a minimum, it would appear to raise the "price of attack" in U.S. re-entry vehicles needed to destroy certain Soviet targets. What that price would be would depend both on the effectiveness of current and potential U.S. penetration aids and on the vulnerability of elements of the defensive system to U.S. defense suppression attacks. For example, a system whose effectiveness relied heavily on information from a small number of large warning and attack assessment radars would be especially vulnerable to disruption.

Mr. Courter: Has OTA done a cost-benefit analysis for any of the likely or possible Soviet countermeasures to an SDI system? Which countermeasures appear to hold the most promise for the Soviets?

Dr. Karas: Even with the best of information, an accurate cost-benefit analysis of Soviet BMD countermeasures options will be difficult--and the Soviet analysis will not necessarily agree with the U.S. analysis. In the absence of specific BMD system architectures and concrete BMD component cost estimates, no cost-benefit analysis at all is possible. We can only identify possible BMD system components and then consider potential countermeasures against each of them individually. And which countermeasures appear to hold the most promise depends on which specific components they are intended to disrupt or defeat.

To take an example, the promise of the fast-burn booster as a countermeasure will depend on the cost to the Soviets of developing and deploying it, the trade-offs in missile capability that such a deployment might impose, the estimated capabilities of the U.S. boost-phase defense layer of its BMD system, the cost to the U.S. of that layer, and the estimated capabilities and effectiveness of subsequent layers of the defense. None of this information is currently available.

Mr. Bennett submitted the following questions to the witness to be answered for the record:

Mr. Bennett: In a "Critical Commentary" (dated October 1985) on the OTA BMD report, Dr. Robert Jastrow and Dr. Frederick Seitz write that the fast burn booster (FBB) is "useless as a Soviet countermeasure" to a boost phase BMD system, and represents this as a "consensus among defense scientists". They make similar remarks regarding the space mine. In OTA's report, these two possible countermeasures are treated seriously. What is OTA's analysis of the countermeasure potential of the FBB and of the space mine? What are the supporting arguments?

Dr. Karas: The objections of Drs. Jastrow and Seitz to OTA's discussion of the fast burn booster reflect misunderstandings of both the capabilities of a ballistic missile defense and the purpose of fast burn boosters.

The statement that a consensus of defense scientists regards the fast burn booster as a useless countermeasure is simply false. All the information which we have been able to obtain confirms that the fast-burn booster is considered a serious challenge to a boost-phase defense. For example, in testimony before this subcommittee on March 4, 1986, General Abrahamson referred to the "impact of fast-burn boosters on boost-phase intercept," citing the synergistic effect of a midcourse defense with a boost-phase defense as a possible mitigating factor. The interest of the Air Force in fast-burn boosters is reflected in its investigation of high pressure, high burn rate fuels and fuel bonding specifications that include the ability to handle loads of 30-130 g's. Synopses of an RFP appeared in the Commerce Business Daily at the end of last year. According to a published report, a purpose of the program, at the Rocket Propulsion Laboratory at Edwards Air Force Base, California, is to provide a knowledge base to evaluate "possible Soviet FBB-based responses to SDI defenses."

As for the criticism of Drs. Jastrow and Seitz, it misses the principal point of the fast-burn booster as a countermeasure: not that it makes a boost phase defense impossible, but that the total engagement time available to the defense is reduced by a very large factor.

The problem is as follows: the prime current Soviet ICBM threat, the SS-18, reportedly has a boost phase which lasts about 300 seconds. Subtracting a nominal time of 20 seconds to initiate a defense against a barrage, A U.S. BMD system would have 280 seconds to deal with the boosters. A fast-burn booster of the best capability postulated thus far in public would take 50 seconds to rise to an altitude of 80 km (still within the upper atmosphere), and then would burn out. Subtracting 20 seconds for initiation, only 30 seconds would remain for the engagement during the boost phase.

Drs. Jastrow and Seitz observe that the booster is invulnerable to some (although by no means all) boost phase attack while within the atmosphere, but remark that the *post-boost* vehicle (the upper rocket stage which dispenses re-entry vehicles containing nuclear warheads) must wait for deployment of its re-entry vehicles (RVs) until the booster clears the atmosphere and becomes vulnerable. Since the delivery system is still vulnerable during the post-boost phase, they argue, the fast-burn countermeasure is defeated. This argument ignores two important points. First, the time taken before the missile can start dispensing RVs is reduced, whether the "post-boost phase" begins inside our outside the atmosphere. Second, it may be possible to reduce the time taken to dispense RVs once the process begins.

Even if one assumes vulnerability during the boost phase within the atmosphere *plus* during the post-boost phase above the atmosphere, the fast-burn booster still would enormously reduce the engagement time. (It should also be remarked that the target is less attractive during the post-boost phase because some of the warheads may already be dispensed by the time the target is hit; thus the leverage killing several wearheads at once during the missile's boost-phase can be severely compromised.) Note that if the engagement time were reduced by a factor of five, the defense, in most practical cases, would need five times as much firepower (i.e. to kill missiles five times as fast) to achieve the same effect. This is of enormous relevance to cost-exchange ratios between defense and offense.

The key question is, how long is the boost-phase plus the post-boost phase likely to last should the Soviets choose to deploy fast-burn boosters? The exact answer is uncertain, but one can note that a booster traveling at several kilometers per second will not take long to rise from 80 km. to an altitude with negligible atmosphere. The post-boost phase could begin at that altitude be accomplished in a far shorter time than for current systems. The criticism notes the OTA report's statement that fast-burn boosters cannot usefully dispense their warheads within the atmosphere (p. 177). However, as noted on p. 208, and misunderstood by the criticism, a rapid dispensing technique, initiated after clearing the atmosphere sufficiently, could be accomplished. This might reduce engagement time from about 280 seconds to the order of 50 seconds, which is greatly to the advantage of the offense. Compared to current Soviet liquid-fuel boosters, the offense would reduce boost-phase engagement time by factor of nearly six. Compared to solid-fuel boosters now being deployed in the Soviet Union, the advantage is close to a factor of four.

An important additional point is, that after burnout, the clear infrared signal from the booster, vital to early tracking, disappears. The defense then must rely on other, far more difficult technologies to detect the target against the earth background. This is another clear advantage of the fast burn countermeasure.

Regarding the space mine, our information again is that the possibility is taken seriously by the Defense Department. The technical analysis of Drs. Jastrow and Seitz is flawed on several grounds. Some of them are as follows:

1. The assumption is made that space mines need be covert or hidden. This is not necessarily true for many scenarios.
2. The assumption is made that space mines have small radii of lethality. This neglects the possibility of nuclear (or even possibly directed-energy) space mines.
3. The argument ignores the possibility of cheap decoy space mines to exhaust the defense. These could follow and approach a quarry to test defenses and draw fire.
4. The argument concerning atmospheric drag and the consequent maneuverability disadvantages to space mines fails in two ways. First, it applies only to low altitudes. Second, even for such altitudes, the argument ignores the offense's option to imitate the ballistic coefficient of the target and reduce or virtually eliminate the difference in drag forces between the space mine and its quarry.

Finally, it is not yet clear which side would have the cost-exchange advantage in space mine scenarios. Cost estimates would be needed for architectures for ballistic missile defense and countermeasures and for space mines, and many strategies would have to be carefully examined. To our knowledge, this has not yet been done.

Mr. Bennett: Dr. Jastrow and Dr. Seitz write that OTA did not adequately report on:

a) the free electron laser, a leading candidate for a ground-based ballistic missile defense laser;

b) atmospheric compensation of optical beams;

c) SCRAMJET technology for transatmospheric vehicles, which could, according to Jastrow and Seitz, reduce the cost of orbiting payloads by a factor of up to 100, irrevocably shifting the balance of power to the defense;

d) electromagnetic railguns.

These items allegedly amount to a serious deficiency and evidence of anti-SDI bias in the OTA report.

Is it OTA's view that this technology was given adequate coverage in its report?

Mr. Karas: In our view, OTA's report adequately dealt with all technologies except the SCRAMJET. The latter made some progress after the OTA report's release, but remains a hypothetical technology. Our detailed comments are as follows:

a) The OTA report devoted several pages (pp. 151-152, pp. 205-207) to the free electron laser and to its inclusion as a weapon of choice in a hypothetical ballistic missile defense system. Further, the report reproduced two relevant drawings from Lawrence Livermore Laboratory (pp. 152, 205). Recent free electron laser progress has been indeed impressive, but years of work are needed in scaling up power, reducing wavelengths, determining whether adaptive optics can adequately compensate for thermal blooming (caused by a powerful beam), and developing practical space-based optics that can handle an intense energy load. Only then will such a technology be a real possibility for deployment as an effective weapon.

b) The OTA report discussed and illustrated the technique (pp. 150-151) of adaptive optics for atmospheric compensation and, in fact, assumed its development as a given. Much successful research and development in this area has gone on for years, both in astronomy and in defense research. As noted in a) the main question is, not whether it can work for weak laser beams to compensate for normal atmospheric turbulence, but whether it is capable of compensating for thermal blooming caused by an intense laser beam.

c) The SCRAMJET was not mentioned in the OTA report. Such a device might make a transatmospheric vehicle (TAV) a reality. The breakthrough referred to in the criticism, announced in a trade publication after the release of the OTA report, consisted entirely of a computer simulation. While earlier announcements spoke of cost reductions of 100 to 1000 for putting payloads into orbit, more recent discussion by TAV proponents refers to a factor of 10 as more realistic. It is widely conceded that years of testing are ahead, beginning with the construction of the first prototype engine, before the technology is proven. Implications of the SCRAMJET and the TAV on the offense-defense balance are not yet clear. While clear advantages accrue to the defense in terms of quantities of payload to place in orbit, the same advantage could apply to the offense. Further, a TAV might turn out to be an effective means of circumventing many possible ballistic missile defenses.

d) The electromagnetic rail gun was described on pp. 155-157 of the OTA report. Dr. Jastrow referred to a test of which he recently learned, that achieved 5 shots in 1/2 second. In such a test, according to the September 1985 issue of IEEE Spectrum, the fifth shot jammed in the barrel. Neither the positive, nor the negative aspects of this particular test determine whether or not the rail gun will be useful for space-based defense. As in all the other areas, much further development is needed, particularly in developing homing techniques whose electronics can survive the large accelerations that are reached.

Dr. **Darden**. We will be in recess until 2, at which time we will take up conventional defense measures.

[Whereupon, at 12 noon, the subcommittee recessed, to reconvene at 2 p.m., the same day.]

### AFTERNOON SESSION

Mr. **Price**. The subcommittee will come to order.

This afternoon, the subcommittee will review ways of improving our conventional defense capability.

Many members of the subcommittee have expressed the concern that not enough is being done to enhance our conventional fighting capability and that there is too much emphasis on strategic initiatives.

It is the objective of the subcommittee to ensure a balanced program between conventional and strategic modernization.

The situation in Europe has not changed substantially during the last decade. We were unable to sustain a prolonged conflict 10 years ago and when I review assessments from the Supreme Allied Commander and other military experts, it appears as though the situation is the same today.

We have convened a panel of experts to today's hearing. I will ask each of the witnesses to offer a very brief assessment, approximately 5 minutes in length, after which we will have an exchange of ideas, questions and answers.

The witnesses before us are Dr. Harold Rosenbaum, HRA Associates; Mr. Pierre Sprey, AMS consulting; Dr. Joseph V. Braddock, corporate vice president, BDM International; Dr. Peter Sharfman, manager, International Security and Commerce Program, Office of Technology Assessment; and Dr. Alan H. Shaw, project director, Office of Technology Assessment.

Gentlemen, who is going to lead off? Dr. Rosenbaum, would you lead off?

### STATEMENT OF DR. HAROLD ROSENBAUM, HRA ASSOCIATES, AND DR. PETER SHARFMAN, MANAGER, INTERNATIONAL SECURITY AND COMMERCE PROGRAM, OFFICE OF TECHNOLOGY ASSESSMENT

Mr. **Rosenbaum**. Thank you, Mr. Chairman.

I am Harold Rosenbaum, president of a small research company, and a member of the Secretary's Defense Science Board, and the Naval Research Advisory Committee. The opinions I am giving today, however, are my own.

In March 1983, President Reagan made a speech about freeing the world from the threat of nuclear weapons. It is interesting to trace the different directions taken by the two initiatives the President discussed: The strategic defense initiatives; and the conventional defense initiative.

Few people even realize that in that speech, he spoke of two initiatives, of an initiative based upon active defense [SDI] and one based upon conventional nonnuclear defense.

In fact, the President said, and I quote, "America does possess now technologies to attain very significant improvement and effectiveness of conventional nonnuclear forces."

To the casual observer, the results of the President's speech were a national security decision memorandum, rapidly followed by the creation of a very high-visibility, focused management office called the SDIO.

It would be very interesting, as we discuss these issues today, to speculate where some of the emerging technology or conventional defense initiative programs would be, had the same kind of management structure been developed for conventional defenses following the President's speech.

That is not to say we have not accomplished an awful lot. I don't mean to imply that at all. Most of the impetus for this has come from a variety of sources, not the least of which has been this committee, which coined the term emerged technology, or ET.

Within the Pentagon, there have been various voices carrying the banner for conventional forces modernization, and the Army and Air Force have come to grips with the problem. They developed a memorandum of understanding which redefines their roles and missions to account for some of the programs that cross the traditional service lines.

The NATO allies have taken some steps. We have developed, and are in the process of fielding real programs. There has been progress, but we still have problems, and let me, from my perspective, step back and tell you what I think they are.

First, I want to define what I mean by follow-on force attack, and what I mean by emerging technologies.

Conventional defense, the kind of conventional defense we are talking about, is really about deterrence. What we wish to do, and again, I quote from the President's March 1983 speech, is "* * * significantly reduce any incentive the Soviets may have to threaten an attack * * *. And here the President was talking about attacking Europe specifically.

How do we affect such an increased conventional defense, in light of the superior numbers of machines and equipment that we face in the Soviet's Warsaw Pact. We do so with a combination of strategy and technology.

The strategy, in NATO parlance, is something we call FOFA, and the technology is ET, or emerging technologies. FOFA is basically a defense in depth, in some way, analogous to the one constructed to defend a carrier battle group isolated in the ocean.

In the case of carrier battle group defense if one took all the resources and tried to defend the carrier at the point of attack, the defense would rapidly be overwhelmed. What has been decided instead is to defend the carrier in depth. That is, take some of the defense assets and go after the Backfire bomber before it launches its cruise missiles, and take another portion of the assets and go after the cruise missiles in their initial portion in flight.

In the parlance of NATO defense indepth interdicts the follow-on forces. Considering the conditions in NATO, considering the peculiar requirements of the defensive alliance, and the forces that we face, we believe that some sort of interdiction like FOFA is necessary to defend NATO.

We still need affordable weapons to effect that strategy of FOFA and that is where ET comes in. In my mind, ET is epitomized in particular by the microchip, is a peculiar technology which the West holds a demanding lead in, and which allows us to put sensing guidance systems literally on the head of a bullet.

The kind of equipment that used to fill a room can now be placed on the tip of a bullet, allowing us to not only detect targets deep in the battlefield, but to place munitions with high lethality very accurately, very deep in the battlefield. This allows the interdict of enemy forces before they come up to the line of contact.

A conclusion I would draw concerning FOFA weapons is that the technology exists to produce them. That doesn't mean the weapons exist, but the technology does, that is, it is not a technological problem. We need affordable, effective weapons, based upon that technology.

Why do I think that problems still exist within the structure that, by the way, both the DOD and Congress have developed on conventional defense.

First, I think a substantive architecture is missing, one that would allow us to determine what portion of our fiscal resources should be put on the contact battle versus what portion of the resources should be put on the deep battle. In the Navy analogy I gave you, it would be equivalent to—how much money do you spend on an outer air battle missile to get the Backfire cruise missile versus how much money do you spend on a close-in weapons system?

We are just beginning to grapple with that problem now in the services, as they protect contact and deep weapons on a system but we still need to develop some sort of quantitative architecture.

Micromanagement is another problem which occurs both in the Department of Defense and in the Congress, and let me explain what I mean in this instance.

The weapons systems required to effect an interdiction strategy like FOFA are really a system of systems, involving many different pieces, including surveillance parts, fusion pieces, buses, attack systems, and munitions. Each of these weapons must contribute to the system of interdiction and each must perform on its own.

These weapons generally have two characteristics that drive their costs. One is survivability on the battlefield and the other one is their robustness to countermeasures.

We have a tendency both in the Department of Defense and in the Congress to require our systems be so survivable as to be invulnerable to whatever threat we can imagine, and so robust as to be able to operate against any countermeasure that the adversary might come up with in a decade or two.

The result of those stringent requirements we place on systems yields us many, many programs in R&D, and very little coming out of the pipeline except Vu-Graphs.

We have got to understand the fact that we need a balance. We need to recognize the fact that invulnerable systems are impossible in this day and age, and countermeasures can always be devised. We have got to develop affordable systems robust enough to keep one step ahead of the adversary, and that means we have to deploy systems before countermeasures are deployed, not the other way around. We have to be the guy who shoots against the countermeasure.

We have to understand that we need to walk before we can run. We need to put systems out there which don't do the entire job, but in the aggregate, create a defense that is robust enough to work.

We have some programs, some of which are very controversial in this committee that are being developed with that in mind.

I am sure when we get into the discussion part, they are going to come up. Sooner or later, we have got to put realistic requirements on the defense procurement process that can result in real hardware instead of Vu-Graph. We have got to decide how far we are going to go in requirements survivability and robustness against countermeasures before we develop a system, put it out into the field, and then develop the necessary improvements.

The Soviets are always making sort of marginal improvements to their systems, and while we might laugh at their low technology, they somehow get things out there fast enough and in large enough numbers to cause us a real problem.

When we are talking about such a complex array of systems, 10, 15, 20 systems that make up this suite of FOFA weapons, no one of those systems will be able to counter the entire threat. We have to develop the ability to put something out and at the same time, develop its follow-on, should that be necessary.

Let me conclude with the three major conclusions I want to leave you with. Defense indepth, second echelon interdiction, deep strike is in my opinion the only way to effect an affordable defense against an aggressor with superior numbers of men and equipment, especially when you are in the particular defensive alignment NATO is in.

Technology is not the limiting factor in the development of the systems currently planned to implement FOFA.

Current weapons, not immune to all countermeasures, are absolutely necessary to stay ahead and maintain an affordable and effective suite of weapons.

With that, I would close.

### Prepared Statement of Dr. Harold Rosenbaum

Mr. Chairman, members of the Subcommittee, thank you for asking me to express my views here today on a subject we all recognize to be one of importance. My name is Dr. Harold Rosenbaum, I am the President of a small defense research firm, a member of the Defense Science Board, and the Naval Research Advisory Committee as well as an independent consultant to industry. The views and opinions I express today, however, are my own.

On March 23, 1983, President Reagan delivered a speech, now quite famous, in which he spoke of a world free from the threat of nuclear weapons. Although few remember, the President spoke of two, not one, concepts to pursue in hopes of achieving this goal. One, of course, was what we know as the Strategic Defense Initiative. The other is what is finally being recognized as the Conventional Defense Initiative.

In the meantime, we will continue to pursue real reductions in nuclear arms, negotiating from a position of strength that can be ensured only by modernizing our strategic forces. At the same time, we must take steps to reduce the risk of a conventional military conflict escalating to nuclear war by improving our non-nuclear capabilities.

America does possess—now—the technologies to attain very significant improvements in the effectiveness of our conventional, non-nuclear forces. Proceeding boldly with these new technologies, we can significantly reduce any incentive that the Soviet Union may have to threaten attack against the U.S. or its allies.

To the casual (and not so casual) observer, however, the result of the President's speech was demonstrated by a series of actions, management and financial, all directed toward SDI. A NSDM was prepared, followed by the creation of a special office reporting directly to the Secretary of Defense and the formation of a highly focused and well funded program. Imagine how far we might have progressed in some ET programs if a similar path was followed for conventional defense. By the way we have an office for the conventional defense initiative but it certainly lacks the visibility and clout of the SDIO.

The impetus for the conventional defense initiative has come instead from a variety of sources and has resulted in some measurable progress. This committee for one, coined the name E.T. for emerging technologies (emerged ?) and has often urged the DoD to move quickly in fielding an appropriate system. The current SACEUR, General Rodgers, has publicly and privately articulated the desperate need NATO has to increase conventional force capability. General Rodgers has managed to get approval in NATO for a strategy called FOFA (Follow-On Force Attack) which defines the need for and use of increased conventional force capability.

Individual members of the Defense Department have carried the banner for conventional force modernization. Concepts have been developed and programs initiated. A MOU between the U.S. Air Force and U.S. Army goes a long way toward clearing a path for the development and acquisition of the various weapons required many of which cross traditional service barriers. Stimulus for multi-national cooperation has been generated in this country in the hopes of developing financial support from NATO members as well as common tactics and doctrine through the efficient development and production of conventional weapons.

We have come a long way but we still face some formidable problems, both technical and management; problems which can only be solved by the combined efforts of the Congress, DoD, and our NATO allies. Before I discuss my view of what these problems are let me step back and define in my own words what conventional defense is all about.

First and foremost improved conventional defense is about deterrence. The situation we face in Europe may admit the perception by the Soviet/WP of a quick conventional victory by a surprise attack. Improving our conventional defense will remove whatever temptation that offers the Soviets. It will deny the Soviets an option which in time of stress they may choose as being in their best interest. It will cause them to consider other less belligerent paths—or in other words it will deter.

How do we achieve this improvement? How do we increase our conventional force capability in face of what appears to be overwhelming Soviet/WP superiority in men and equipment? We do this with a combination of strategy and technology: and here is where FOFA and ET come into the picture.

FOFA is a NATO strategy and although supported by various U.S. strategies it is uniquely designed to fit the peculiar requirements of NATO as a defensive alignment. This is a subtle but important difference. NATO forces are expected to neither yield land to any aggressor nor advance beyond current boundaries. In the U.S. we talk of second echelon interdiction, deep strike attack, air-land battle, etc. In NATO we speak of FOFA.

What all these strategies have in common can be likened to the concept of defense in-depth. It is the same concept, for example, that the Navy uses in the defense of its aircraft carrier battle groups. We are all familiar with the Backfire launched cruise missile threat to an aircraft carrier. In order to defend that carrier it is much more efficient to allocate some portion of the defense to attacking the Backfire before it launches its missiles, to attacking the missile in the initial portion of its flight and finally to a close-in sort of last-ditch defense.

FOFA, or second echelon interdiction, can be viewed in a somewhat similar way. Simplistically speaking a defensive position can be maintained in a ground battle under some force ratio which favors the aggressor. That is, one unit of defense can hold off some number of units of offense, perhaps 2-3. However, an offensive threat will succeed when the favorable ratio reaches some higher value, say 4-5 to one. That is, 4-5 units of offense will confidently break through one unit of defense. And that is what the Soviet/WP strategy is all about. Being the aggressors and possessing superior numbers of new missiles and equipment they have the ability to create a favorable force ratio at places of their choice. Follow-on forces would exploit this, crumbling NATO's defenses. In the words of General Rodgers, NATO could hold out a few days and then he, as SACEUR, would have to request release of nuclear weapons. The FOFA and second echelon interdiction strategies are designed to keep the force ratios at the FLOT at levels consistent with successful defense and to do so by the delay, disruption and attrition of those Soviet/WP forces which follow the initial attack and create the conditions favorable to a Soviet breakthrough. There is no other way to effect a defense against superior numbers under conditions wherein retreat, even temporary, is an unacceptable strategy: FOFA or a similar defense in-depth strategy is an absolute requirement.

Technology, ergo the name ET, is supposed to supply us with the West-unique weapons to implement this strategy: systems for surveillance and target acquisition; attack systems; and C$^3$I systems. One of the most fundamental ingredients in all these ET systems and a key to the West-unique advantage is micro-electronics: "the chip". The "chip" allows the performance of sensing and guidance functions by equipment that at times can be literally placed on the "head of a bullet": it took a room full of equipment to do the sensing and guiding job before the "microchip". Because of this we can see deep and detect a variety of emissions; we can integrate huge volumes of data; and, we can deliver extremely accurate and highly lethal conventional weapons deep into the battlefield. In terms of range payload some of these weapons have a potential lethality against military targets approaching that which previously could be achieved only with nuclear weapons. The technology exists today to implement FOFA; its integration into usable and affordable weapons is just barely beginning to emerge.

These, then, are the two building blocks for creating an increased conventional deterrence: a strategy which in the defensive parlance of NATO is called FOFA; the West's unique technologies which permit the development of weapons to implement that strategy. Why then does it appear that progress has been slower than one would hope? In recognition of the extreme complications, both technical and management, and with benefit of hindsight, let me offer my personal views of what I think is still wrong!

I find disturbing the lack of a substantive architecture which could be used to guide the resource allocation process (used by the DoD and approved by Congress) in a more quantitative fashion. Clearly, there is not enough money to do everything that can be done and somewhere in the process a resource allocation must be made that says we spend so much on systems which basically defend at the FLOT and so much on systems which, by interdicting; by delaying, disrupting and attriting follow-on forces allows us to most efficiently manage the force ratio at the FLOT. This is a difficult architecture to construct, involving the combination of operations analysis, exercise data and plain old military judgment. To date, in my view at least, this has not been sufficiently addressed and causes not only the potential for less than optimum resource allocation but for indecisiveness within the DoD management system and the Congressional approval cycle. Perhaps had CDI followed the SDI path, with a strong focus on upper management, more progress would have been made towards this end.

It is important to recognize that the ET weapons needed to implement FOFA or second echelon interdiction, really form a "system of systems." They consist of many different weapons which, when operated together, implement the strategy. There can be no achilles heel permitted in such a complex system of systems and there must be some regard given to the needs of the whole. Our tendency both in the DoD and in the Congress, perhaps because of our budget process, is to micromanage. We concentrate on one piece, or one system, in the system of systems, put it under a microscope, and place requirements on it as if that one piece had to do the whole job against the entire threat spectrum. The results of such management is obvious: false starts, wasted money, delayed procurements—viewgraphs rather than weapons. This is an example of what I mean by a problem that has to be jointly handled by the DoD and Congress. No one piece of this system of systems is going to be perfect or near perfect. We have got to begin demanding that something come out the pipeline and that might mean we have got to start accepting pieces that don't do everything and cost the national treasury. That is why although ET may stand for emerging technologies, EW doesn't stand for emerging weapons.

There is an analogy which might help explain my concerns. A few years back I bought an Apple computer for home use as many people did. Some of my learned colleagues argued that if I waited I could get a bigger, better, faster and cheaper computer. They were right, of course, and my Apple is almost obsolete, at least by some standards of comparison. However, had I not bought that system two years ago I might be obsolete today. Congress and DoD need to assure that the current programs of FOFA weapons are not delayed even though future systems may appear to satisfy more stringent requirements.

Becoming a little more specific I am still concerned about what seems to be a poor balance between munitions and platforms. Again, it is easy to blame this state of affairs on the Services, saying they feel it's more "fun" to fly an airplane or drive a tank than to buy munitions. But Congress too must accept some blame.

There are, and there should be during some phase of R&D, a relatively large number of potential munitions. The tendency of both DoD and the Congress is to "micromanage the dickens" out of each separate munition program which in turn leads to delays and then an increase in the number of separate programs. I don't mean to imply that the DoD has done as much as it should to get its act together but simply stopping programs and requesting master plans won't solve the problem. Somehow the down-select process which is supposed to focus quickly on a choice to carry through to production has got to be accelerated and goals for production clearly developed.

I recognize that platforms are no good without munitions but at times Congressional oversight exacerbates the problem. Faced with what it may perceive to be an indecisive and poorly managed munition program, Congress sometimes reacts by slowing or even cancelling the platform that will eventually incorporate that munition telling the DoD that when they get their act together on the munitions to come back for approval of the platform. The result, of course, is that the country gets nothing except the ever present viewgraphs. What should be done is to urge the DoD to accelerate the lagging program in order to develop a system which could be procured and deployed even if it is not the ultimate weapon.

I would like to add a message to the critics of the high technology weapons being developed to increase NATO's conventional defense. These so-called ET weapons are not gadgets that will be too complex for the battlefield any more than they are weapons to make the world safe for conventional war. They are systems designed to increase conventional deterrence. They are based upon what the West does best—high tech. The final and hopefully only proof is the increasing amount of evidence that the Soviets are reacting to our announced plans with some concern. I certainly hope we equal that concern with deployed systems.

In conclusion let me summarize as follows. A strategy such as FOFA or second echelon interdiction, deep strike, etc., is absolutely necessary if NATO is to defend against the superior numbers of Soviet/WP forces. Technology is not the pacing item in the development of the weapons systems needed to implement that strategy. In fact, the West is significantly superior to the Soviet Union in those specific technologies required.

As we develop weapons utilizing advanced technology, in order to implement FOFA, we need to be realistic about the utility and survivability of individual systems. There is no system that cannot be countermeasured. There is no system that can remain invulnerable in this day and age. By constructing a robust system of systems we can so occupy the aggressor with his development of countermeasures and attack strategies that he will have been denied his primary objective. To do so, however, requires weapons and not viewgraphs. If we wait for the ultimate weapon—non-countermeasurable and invulnerable—we will wait forever.

Mr. PRICE. Mr. Badham.

Mr. BADHAM. I have no questions.

Mr. PRICE. Next witness, and then we will question.

Mr. Sprey.

## STATEMENT OF PIERRE SPREY, PMS, INC.

Mr. SPREY. Thank you, Mr. Chairman.

I would like to speak from a short set of briefing slides, if I may. I would like to take a slightly different approach from Mr. Rosenbaum.

The approach I would like to take is to focus on, as specifically as possible, the forces that need help and the kinds of weapons that would help them. To set the stage for this, the best way to think about where our forces need help is to think about a very simple case example of a defense situation in Europe, one that will inevitably happen if there is a NATO war and one that probably stresses the kinds of technologies we are thinking about to the absolute maximum.

That example is very simply the case of a Soviet breakthrough. Beyond the shadow of a doubt, if the Soviets bring massive forces to bear in Europe, they will create a breakthrough, because anybody who masses enough divisions on a narrow front can create the breakthrough.

The real question is, will our forces stand or collapse at that point? What do we have to bring to bear on that breakthrough that can turn it from a disaster into an opportunity?

Why are breakthroughs so stressing, and such a good case for filtering out less useful technologies so they can be replaced by useful ones?

First of all, a breakthrough situation creates the maximum of chaos and unpredictability. Think of the case of four or five Soviet divisions that have broken through one of our forward defense positions. They are now amongst our cooks and bakers, completely intermeshed, interleaved and almost indistinguishable from our own forces—all the while raising immense havoc.

The first thing you will see is that this critical battle case completely invalidates the idea of deep attack, deep interdiction and FOFA, because the front lines have disappeared. There are no more front lines in a breakthrough case.

Second, this case makes a mockery of the normal NATO concept of a forward defense. Once you have a breakthrough, strong reserve forces are essential, and heavy forces allocated to forward defense are the worst possible thing you can do if you expect breakthroughs.

Naturally, all kinds of communications and fusion centers go to hell in a handbasket. You generate a tremendous demand for being able to move forces fast; that is, bringing reserve units to bear at maximum speed, because the breakthrough itself has created a situation where your forces are maldeployed. Thus, you need to respond as fast as possible; you are stressing the movement ability of large force units, not just simply the maximum speed of individual trucks and tanks. The breakthrough also creates hundreds of cutoff units, so the extent to which your units can operate autonomously becomes very important.

You can almost guarantee that, in a breakthrough situation, intelligence and reconnaissance will be too late, and mostly irrelevant.

In a breakthrough situation, with friendly and enemy forces so tightly interleaved, the question of positive identification of the targets you shoot at becomes crucial.

If you think about it, you will realize, of all the sensors available, the only one even on the drawing boards that allows positive enough identification when friendly and enemy units are so closely interleaved is the Mark-1 Eyeball. Thus, positive identification and the eyeball becomes a dominating factor in all fires, artillery, air-delivered fire, tank fire, et cetera.

Keeping in mind this picture of the breakthrough situation, stop and think about the forces we have that will really be able to help counter such a breakthrough, seal it off, if possible counterattack, and thereby put large Soviet forces in the bag and into the prisoner of war camps.

Let me assert briefly that of all the types of forces we need in that situation, the one type of which we have the least, and the one that most needs to be strengthened is the fast infantry reserve. Specifically, this means fast-moving, light infantry units that can help to counter attack immediately, to move quickly into areas that have been overrun, and that can deal with armor-heavy forces. That is probably the single greatest weakness our NATO forces have, most particularly the greatest weakness of our own

U.S. forces in NATO. Now what is the main deficiency of the U.S. infantry now in Europe?

It is basically that none of our infantry's antitank weapons work. They are as naked against Soviet tanks as we were in the darkest days of World War II, when U.S. airborne units had to make improvised weapons on the battlefield, or to resort to captured enemy weapons to fight off German tanks.

The most important type of infantry, after fast infantry, one that could make a big difference in a NATO war, is territorial infantry. The Germans have large numbers of territorial forces that could be extremely valuable if they had effective antitank weapons, which they don't.

The key to developing fast infantry that can stand up to tanks, and to finding large numbers of useful territorial infantry, is to give them decent antitank weapons.

The second most important weakness in Europe is armor, and the weaknesses there are very clear. First and foremost is the fact that our tanks are disastrously flammable, far too vulnerable.

There is a major program underway in the Department of Defense that is starting to bite off the tip of that iceberg, it is called the Live Fire Program.

Just as important is the fact that we have too few tanks. We keep on talking about the tremendous numerical superiority of the Russians in tanks, but we keep on buying tanks that guarantee them a even larger superiority in the future.

Last, with the kind of tanks we are buying today, we in fact, create a tank forces with very slow unit mobility. Individually, the tanks may be very fast in top speed. When you have to move them by battalions, they are slower moving than previous tanks, due to breakdowns and a very heavy tail for fuel, spares and maintenance.

The next force that most needs help, and the most useful, next in the case of a Soviet breakthrough, is close air support. Air has a lot to offer in the case of a breakthrough, because of its extraordinary mobility.

To make that potential work, it has to have effective capabilities against simple targets like trucks, tanks, artillery, and so on.

Our U.S. close support capability is rapidly becoming nonexistent, mostly because the Air Force and Navy have little interest in the mission.

To the extent the mission is kept alive today, it is kept alive by the interest of the Air National Guard, and in fact, we have almost no forces left in the active forces that are capable of doing close support.

The next force that needs help very badly is the artillery, and the artillery needs help in one very specific area, and that area is very similar to the previous area, the close-in support of infantry.

We have almost completely lost our capability to support infantry closely with artillery, because the artillery, for traditional reasons, prefers the longest possible range weapons of the largest caliber. Because we have almost completely dropped light 105-millimeter cannons, we have converted our artillery largely into large antifortress artillery. This gives us slow rate of fire and rounds that are much too big to drop in close to infantry. So the artillery very badly needs help in that one specific area of getting rapid fire weapons suitable for closely supporting infantry—as opposed to the area that they seem to prefer, which is large, long-range pieces for attacking heavy, static targets like bunkers, and dug-in enemy artillery.

Lastly, a very critical naval area, absolutely vital to the defense of Europe, is the question of whether we can keep the sea lanes across the Atlantic open. I would say that any disinterested observer who stops and thinks about it for a little while will see very clearly that we have not a chance today of winning a modern-day battle of the Atlantic.

At present, we are vastly more outnumbered in submarines than the Allies ever were. We are outnumbered about three to one in today's peacetime, and there is a very good chance it would get much worse in wartime.

Even worse, we have made the fatal error of having our entire submarine fleet depend on one torpedo, the Mark-48. If historical precedents have any meaning here at all, we are likely to have a torpedo disaster at the opening of any naval conflict.

The perennial torpedo problem is exacerbated if you depend on only one torpedo. Not only is this true of our submarines, the same thing is true of our surface forces. They depend on the Mark-46, which is a surprisingly ineffective torpedo. Because of both questionable torpedoes, and a crippling lack of numbers of submarines, we are in terrible shape to defend the sea routes across the Atlantic.

To show you that there is plenty of budgetary room to help those forces that so badly need help, look at the forces that least need help. This is where you would be able to get the resources to help the forces that really need strengthening.

I will mention those forces that least need help. It is curious that they happen to be those that absorb the largest amount of R&D and production money, so there is no question that small transfers from those forces that least need help to the ones that need strengthening could make a terrific difference.

First and foremost among expensive forces that least need help is long-range air defense, air defense for division level and higher.

It is pretty obvious why large bureaucratic structures would like to defend higher level organizations; unfortunately, that is the opposite end of the battlefield from what needs defending.

We most need defending at the foxhole level, squad level. That is where we have little or no air defense. That is true for several reasons.

First of all, for the reason that Soviet air still does not match ours in range. It is far from matching ours in tonnage, and the Soviet deep bombing threat is greatly exaggerated.

At the same time, we know that the Soviets will concentrate their fighter activities relatively close in, either over their own forces or over our forward elements, and that is where we need to emphasize air defense, and that is where we have very little of it.

Another very expensive area in which almost all of our tactical air R&D and production is concentrated is the area of interdiction, interdiction bombing of the kind we did in World War II, Korea, and Vietnam. It didn't work in those wars and is very unlikely to work with the next. In fact, the alternative to deep interdiction, close support, is something we spend less than 1 percent of our tactical air budgets on.

The room for improvement in this very important area is obvious.

The fourth area on which we have spent a great deal and which we do not need to help any more is the area of armed and lift helicopters. These are particularly less useful in Europe because of the problem of vulnerability of helicopters. Helicopters in the dense air defense environment in Europe—due to their inability to out maneuver AA fire or missiles and their vulnerable apparent airframes are unlikely to last as much as 2 or 3 weeks. We have developed an enormous air force of helicopters, despite that fact.

Last is the area of long-range artillery. We have converted almost all of our once-superb infantry-supporting artillery into long-range antifortress artillery. We need no more help in that area.

I would like to talk about the opportunities for a modest program that could in fact make a very large difference in our ability to defend successfully in Europe. Let me get very specific very quickly, and go in order through the forces just mentioned as needing help the most, starting with infantry.

More than anything else, infantry needs some weapons that beyond the shadow of a doubt will stop Soviet tanks, not on a what if basis or a maybe if they get reliable tomorrow basis, but here and now weapons to stop Soviet tanks. Of such weapons, the most important is the squad antitank weapon. This is an area in which we have failed our soldiers for almost 40 years. I propose very simply that we find a competitive shootoff of existing weapons that do work, of which their are plenty of in NATO. I am proposing that we have a very realistic shootoff of squad level, light weapons that work, pick one that works, and they buy it in large quantities manufactured under license in the United States.

We also badly need a higher level heavier, rapid-fire antitank weapon, a battalion level antitank cannon for specialized antitank units. Why? We have tried, and tried, and tried to make missile technology work against tanks, and so far, we have largely failed for a number of fundamentally technical reasons, not the least of which is that the missiles we have produced have an extraordinarily low rate of fire—much too low to be effective against massed tank attacks of the type the Soviets espouse.

I am proposing that we follow the lead of the Soviets in this case; they developed and fielded antitank missiles similar to ours and while maintaining in-inventory very modern antitank gun technology. They are building lots of modern, towed antitank cannons; every Soviet infantry division has 18 of them. They have very high velocity and lethality and stand ready to back up missiles when and if missiles fail.

I propose that we have a prototype competition for towed antitank cannons even more effective than the Soviet ones. There is a United States design of such a cannon, an Israeli design, and an existing Finnish weapon, which could provide exactly this backup against the probable and likely failure in combat of the U.S. antitank missile weapons, that is, the TOW and Dragon.

If you are interested in fast infantry, infantry with much greater mobility than tanks, a type of force which we have been unable to organize and establish so far, I would propose that we establish an experimental infantry battalion, based on a much faster means of transportation than the tank, that is, based almost entirely on motorcycles.

And I propose we do it in the National Guard, because it would find a more receptive home there than in our more conventional thinking forces.

And last, I propose, because of the terrific importance of weight to the infantrymen, because his entire effectiveness is dominated by the question of what he can carry on his back, I propose we start an R&D program to develop ultralight infantry equipment of every sort, from entrenching tools, to tripods, all the things he has to carry. There is no reason why modern technology can't halve the weight of most of those things the infantryman must carry. We thereby double his possible firepower, because lightening these items allows him to double his ammunition load, double the weight of the rounds and weapons that he carries.

The next most important area is armor. I would like to propose——

Mr. McCurdy. Mr. Chairman, could I ask a question on that point?

On your infantry proposal, can you give us an assessment of such things as the Stinger, in your opinion as far as where we are in technology, and whether, for instance—the reason I raise this is there have been a number of suggestions that perhaps we ought to give something like a Stinger to the Contras, and I am curious as to whether this is a technology that has already perished or if it is such that we don't want it to fall into enemy hands?

How would you rate the current technology like that? I am curious to get some perspective here on conventional.

Mr. Sprey. The purpose of Stinger was to provide forward area air defense in exactly the area I just mentioned that needs air defense, squad, company, battalion level.

We don't do much in an area to try to provide air defense. I think Stinger falls far short of the mark in many respects.

First and foremost, and this is based on some studies actually done of Stinger firing results, it has very low capabilities against maneuvering targets. Second, it has real vulnerabilities to modern infrared flares, little golf ball sized fireworks that can distract most infrared missiles.

And third, perhaps most seriously, you have to think about this question of what the infantry can carry with it, the question of weight constraints. Infantry, at low levels, cannot afford to carry a weapon that they might use once a week or twice a week, and that has no other use for the day-in, day-out grinding combat they face.

In the past, light antiaircraft weapons of the kind issued at battalion level, 50-caliber machineguns, have been extraordinarily useful in ground combat. For every time they had a chance to fire at an airplane in combat, they fired 50 times at ground targets.

The Stinger is completely useless in ground combat, deadweight until the airplane shows up, and when it does, you have a very low chance of hitting it if——

Mr. McCurdy. Rate it against an MI-24.

Mr. Sprey. If the MI-24 helicopter is not carrying flares, the Stinger might have a fair chance of shooting it down. If the helicopter carries flares, the Stinger is likely to prove harmless. I would not expect that even in the lowest level combat of the next few years that you would encounter any air vehicles that don't have flares. They became standard in 1982 in Lebanon, and everybody learned a lesson back then.

Mr. McCurdy. You would think that a heavier machinegun, especially in low-intensity conflicts, Western Europe, would probably be as effective as would something like a Stinger.

Mr. Sprey. Much more effective, considering the range of combat tasks that soldiers at that level have to accomplish.

Mr. McCurdy. Very good, thank you.

Mr. Sprey. The next area, very briefly, is the question of armor.

The first and foremost problem we have in armor is that our amored vehicles are among the most flammable and the most explosive in the world. We owe our armored troops better than that.

It is easy to fix those vehicles. I am proposing for the very large numbers of M-48's and M-60 tanks we are going to keep well into the 21st century, we undertake a crash program to change their extraordinary flammability into extraordinary survivability.

It is easy, straightforward to do, and one of the cheapest programs we have got listed here.

Next, we ought to do more advanced research in the same area, an intensive program of advanced research on ways of reducing the flammability and explosiveness of all the dangerous stuff we put inside tanks today, working on less sensitive propellants for ammunition, hydraulic fluid that doesn't burn, et cetera, et cetera.

That is the highest priority we have in armor. The other problems of armor are larger and harder to deal with; of these the foremost is how to produce a tank at a decent price that will allow us to produce the same number of tanks as the Soviets.

That is entirely technically feasible. The only problem is a bureaucratic one.

The next mission area is close air support, which could make a real difference in Europe. In view of the fact we have a vanishing capability in close air support and zero interest in either the Air Force or Navy in producing a followon to the A-10, it would be important for this committee to encourage that process by starting a fly-off competition for new close air support airplanes, a very small, agile and lethal airplane that would be intended from the start to be bought in numbers amounting to at least 2,000, and preferably 6,000, airplanes.

That can all be done for less than the price of an expensive modification program like the F-15E program that we are undertaking now for a much less worthwhile mission, the same old interdiction mission.

In artillery, our most important contribution would be to start a program for an artillery piece specifically designed for the close-in support of infantry. This is very easy to do; there have already been promising starts in that direction.

Here we are looking for a prototype shootoff of a lightweight, 105-millimeter cannon, this gun would have a much higher rate of fire, particularly for short bursts, three- to five-round bursts, than any 105 we had before. We need to have a shootoff of such a 105 against the NATO 120-millimeter mortar, an infantry support weapon that has a lot of those characteristics that we need.

In the antisubmarine area, so critical to keeping open a lifeline to Europe, I would propose, first and foremost and more important than any other single submarine subject, we badly need to have a realistic operational torpedo shootoff.

We must find out whether our total reliance on the Mark-48 will lead us to disaster or not. We need a competitive shootoff of the U.S. Mark-48 against the standard modern NATO torpedoes, of which there are several. It would be useful to see how the new developmental U.S. Mark-48 ADCAP torpedo does in that shootoff.

We need to do the same thing for the Mark-46 light torpedo that is the only ASW weapon of our surface forces. Given its relatively ineffective warhead and its countermeasurability, I can assure you that we have no surface forces today—either long-range patrol aircraft, destroyers, or any other surface ASW forces—that are capable of reliably sinking Soviet submarines.

Finally, the very important U.S. submarine force itself. This may well be the most important component of keeping the sealanes of the Atlantic open. We need two new R&D programs to change the traditional mind set of the submarine program, the narrow focus it has had since the advent of Admiral Rickover.

One is a very new and very different nuclear electric propulsion system designed to be far more compact than the ordinary nuclear boiler propulsion that we are using today. This would be based on space technology already developed for space nuclear power generators, that is, the direct generation of electric power without the use of steam from nuclear energy.

This would be a terrific step forward, would allow us to greatly decrease the size of our subs, and allow us to make them far more quiet.

The other thing I would propose is a parallel program for conventional, nonnuclear submarines. Nonnuclear subs are very important to us. If we really want to match the much larger Soviet submarine force, we must in part rely on conventional submarines at around the cost level of diesel electrics.

There are modern technologies that allow such submarines to extend their range under water, and I would propose a very heavy R&D effort in the area of nonnuclear electric propulsion, specifically, the fuel cell or any of its nonair breathing alternatives.

Let me summarize by saying, what I have proposed here is a relatively modest conventional defense initiative, very small in the scale of the very large R&D programs we are carrying out in much less important mission areas.

This conventional defense initiative amounts to about $1 billion in the fiscal 1987 R&D budget. If we can maintain the focus of this kind of conventional defense initiative package on those forces that need help—infantry, close-in artillery, close air support, and keeping the sealanes open—if we can keep that focus, then even this small a package could make the difference between U.S. forces collapsing in the face of a Soviet breakthrough in Europe versus United States forces prevailing and creating a successful defense.

Thank you.

[The charts of Mr. Sprey follow:]

# CREATING AN EFFECTIVE DEFENSE OF EUROPE:

# WHERE DOES TECHNOLOGY FIT IN?

# THE CRITICAL, STRESSING TEST CASE FOR ANY NEW TECHNOLOGY FOR EUROPE: THE SOVIET BREAK-THROUGH SCENARIO

- MAX CHAOS/ UNPREDICTABILITY
- WIPES OUT FRONT LINES (FEBA)
- MAKES MOCKERY OF FORWARD DEFENSE
- GENERATES COMMUNICATIONS/COMMAND OVERLOAD
- FORCES MAX SPEED MOVES OF RESERVE UNITS
- CREATES HUNDREDS OF CUT-OFF UNITS
- ENSURES INTELLIGENCE AND RECONNAISSANCE WILL BE TOO LATE
- DICTATES 100% POSITIVE EYEBALL ALL FIRES (E.G. ARTY AND AIR)

# WHAT FORCES NEED HELP THE MOST?

| FORCE | WEAKNESS |
|---|---|
| • FAST INFANTRY<br>• TERRITORIAL INFANTRY | OUR INFANTRY ARE NAKED AGAINST TANKS BECAUSE THEIR ANTITANK WEAPONS DON'T WORK |
| • ARMOR | TANKS MUCH TOO FLAMABLE; TOO FEW TANKS; SLOW UNIT MOVES |
| • CLOSE AIR SUPPORT OF INFANTRY/ARMOR | ALMOST NON-EXISTENT EXCEPT IN AIR GUARD |
| • ARTILLERY CLOSE SUPPORT OF INFANTRY/ARMOR | VANISHING CAPABILITY DUE TO EXCESSIVE CALIBER AND SLOW RATE OF FIRE |
| • ASW/SUB PROTECTION OF ATLANTIC ROUTES | WE CANNOT WIN THE BATTLE OF THE ATLANTIC TODAY -- OUR TORPEDOES PROBABLY DON'T WORK AND WE NEED AT LEAST TWICE AS MANY SUBS |

# WHAT FORCES NEED HELP THE LEAST?

| FORCE | COMMENT |
|---|---|
| • DIVISION AND HIGHER AIR DEFENSE | SPEND FAR TOO MUCH ON DEFENDING HQ; SOVIET BOMBING THREAT IS RELATIVELY WEAK |
| • DEEP INTERDICTION TACAIR AND MISSILES | INTERDICTION BOMBING FAILED IN OUR LAST THREE WARS, YET WE SPEND LESS THAN 1% ON CLOSE SUPPORT |
| • ARMED AND LIFT HELICOPTERS | WE SPEND MORE ON HELOS THAN ON INFANTRY EQUIPMENT, THOUGH HELOS CAN'T LAST IN EUROPE FOR THREE WEEKS |
| •LONG RANGE ARTILLERY | HAVE CONVERTED NEARLY 100% OF ARTILLERY TO LONG-RANGE ANTI-FORTRESS GUNS. VANISHING CAPABILITY AGAINST CLOSE-IN SOV MASSES OVERRUNNING OUR TROOPS |

# A PROPOSED CDI PACKAGE IN R & D

**INFANTRY:**

- SQUAD ANTITANK COMPETITIVE TEST (NATO WPNS), $100M
- TOWED AT CANNON R&D PROTOTYPE COMPETITION, $150M
- ESTABLISH EXP'L MOTORCYCLE INFANTRY BATTALION-GUARD, $30M
- ULTRA-LIGHT INFANTRY EQUIPMENT R&D, $50M (COMPETITIVE USMC/USA)

**ARMOR:**

- DEVELOP & LIVE-FIRE-TEST SURVIVABILITY RETROFIT PACKAGES FOR M48, M60, M113(PARTICULARILY FOR GUARD),$60M
- R&D IN MAJOR REDUCTION OF TANK SUSCEPTIBILITY TO FIRE AND EXPLOSION, $30M

# A PROPOSED CDI PACKAGE IN R & D

| | |
|---|---|
| CAS: | • 3-WAY PROTOTYPE FLYOFF FOR NEW, MAXIMUM-AGILITY CLOSE SUPPORT AIRCRAFT FOR AIR GUARD, $300M |
| ARTILLERY: | • PROTOTYPE COMPETITION OF LIGHT, RAPID-FIRE 105MM (TOWED) VS.NATO 120MM MORTAR, $100M |
| ASW/SUB: | • SUBMARINE TORPEDO SHOOTOFF,$200M (MK 48 VS NATO VS NEW)<br>• LIGHT ASW TORPEDO SHOOTOFF,$150M (MK 46 VS NATO VS NEW)<br>• ULTRA -COMPACT/QUIET NUCLEAR-ELECTRIC PROPULSION R&D FOR SUBS, $200M<br>• ULTRA-QUIET NON-NUCLEAR ELECTRIC PROPULSION R&D (FUEL CELL), $150M |

# WRAP-UP

- RECOMMEND MODEST CONVENTIONAL DEFENSE INITIATIVE OF ABOUT $1BILLION IN FY 87 R&D
- NEED FOCUS ON INFANTRY, ARMOR, CLOSE SUPPORT, CLOSE-IN ARTILLERY, AND ASW/SUBS IN THE ATLANTIC
- A PROPERLY-FOCUSED CDI PACKAGE CAN MAKE THE DIFFERENCE BETWEEN SUCESSFUL DEFENSE OR COLLAPSE IN EUROPE

Mr. PRICE. Mr. Braddock.

## STATEMENT OF DR. JOSEPH V. BRADDOCK, CORPORATE VICE PRESIDENT, BDM INTERNATIONAL

Mr. BRADDOCK. My name is Joseph Braddock, I am with the BDM Corp., a member of the Defense Science Board, and I have a few brief things to say relative to the guidance you gave us earlier.

I believe you are on the right track looking for the balance between strategic and conventional. I believe the suggestions derived from the President's statement made by Dr. Rosenbaum might provide the right kind of umbrella for you; that is, to look for a conventional defense initiative.

Let's suggest you have already executed part of that, or at least set it in motion. You have been working with the services, Department of Defense, to get a deep attack, if you will, capability for air and ground in place.

And by and large, what is on the books to be executed and the programs intended to reduce some of the risks that we are taking are the right things. They are not perfect, but they are the best choices we can make today, and we have made the first right step.

What we should do is to revisit the other areas. You have heard detailed testimony prior to my comments.

I would suggest there are a few things that you could look at; for example, the Defense Science Board this past summer, on which Harold Rosenbaum and I work, we looked at the competition in the closed battle.

I believe we did a fairly comprehensive job. I suggest you review the close battle. It is a rather sophisticated problem.

We are up against an implacable foe in that regard who is modernizing in quantity and quality at a pace which this world hasn't seen in the past.

We will have to be extremely clever and careful in the way in which we structure programs to redress the imbalances that exist, and set ourselves on a course in which we can compete for the long term.

I might add that the Secretary of Defense reviewed with the Defense Science Board findings charged the services with an immediate action and a continuing review. They have moved out. I recommend you look at their programs, along with those of the Defense Advanced Research Projects Agency.

That does not put an end to the problems we have. We have additional difficulties, if we are going to reduce our dependence on nuclear weapons, which is, after all, the thrust of this whole activity, and to counter problems where the Soviets have free options.

Some of those lie in the conventional missile area, where we do need ATM capabilities. I suggest that you seek an umbrella under which to look at conventional defense initiatives that really lift up our capabilities on a larger scale and deter the Soviets. We can then buy the time to put the right things in place for the long term. We are in a long-term competition with an adversary who enjoys numbers, a huge economy on which to base a war machine, and the willingness to spend the money to buy a war machine year after year.

We have a difficult problem on our hands, and I don't believe it can be fixed with one or two modest things. I believe you do need an umbrella. The conventional defense initiative is not a bad way to describe that umbrella.

Thank you very much, sir.

Mr. PRICE. Dr. Sharfman.

Mr. SHARFMAN. With your permission, Dr. Alan Shaw, the Project Director, will present the OTA statement.

## STATEMENT OF DR. ALAN H. SHAW, PROJECT DIRECTOR, OFFICE OF TECHNOLOGY ASSESSMENT

Mr. SHAW. I will go briefly over some of the things we have done to date. The prepared statement is fairly lengthy, so I will touch on some of the highlights of it.

We have brought the project staff along with us, seated behind me, and I may refer to them to answer some of your questions later on.

Several months ago, Ambassador David Abshire, the U.S. Permanent Representative to NATO, wrote that one of NATO's critical deficiencies is "insufficient means for defeating, disrupting and destroying enemy follow-on forces."

There are steps that could be taken in the very near future to improve NATO's ability to use what it already has, but the greatest opportunities appear to lie in exploiting technology that is now fairly far along in the development process.

Unlike ballistic missile defense, which as OTA testified earlier rests heavily on technology only now beginning to emerge from the laboratory, FOFA could exploit technology that is available now, and technology that is likely to be mature over the next decade.

While most of these developments are relatively mature, not all have been fully demonstrated; at this time, we cannot say with absolute confidence that they will all work as advertised.

Furthermore, it will be necessary to test complicated combinations of systems under realistic conditions before we can be sure that such combinations will really be useful.

In our special report, that we recently completed, we were asked to provide an overview of the developments of interest. In doing so, we were led to the following observations:

First, these developments only make sense in the context of operational concepts for attacking follow-on forces.

Second, existing and proposed systems should be viewed in terms of complete packages for supporting the operational concepts.

Third, the elements of those packages will have to be procured in sufficient numbers if the capability to attack follow-on forces is to be significant.

In our discussions with the services and others, we have been able to identify several lines of U.S. thinking that, although somewhat different, are mostly compatible.

The U.S. Army appears to have one perspective, while the Air Force has a somewhat different one. However, the services have taken a number of measures to coordinate their approaches.

The Army perspective is influenced by the ground battle they expect to be fighting, by the range of their artillery and MLRS, and by their air-land battle concept. The enemy forces within range of MLRS and artillery could reach U.S. forces in a few hours, and the Army will want to identify and attack the most threatening of them, targeting individual battalions or perhaps even companies.

Since they expect to be using a limited number of weapons in a target rich environment, targeting selectively will be important.

Air interdiction, a foundation of the Air Force approach to FOFA, is likely to extent considerably deeper in to the enemy rear, where it is less likely that the intentions of the individual battalions can be ascertained.

Air Force targets will be regiments, or perhaps even entire divisions, selected after coordination with ground force commanders.

Thus, the Army and the Air Force would be doing somewhat different, but complementary jobs. An increase in effort by one could, at least in part, compensate for a reduction in effort by the other, but the two would not be interchangeable.

Some analysts view follow-on forces attack as a way to compensate for NATO's difficulties in quickly shifting ground forces to respond to Soviet actions. For example, a rapid massing of Soviet forces to break through a weak section of NATO's defenses or the insertion of an Operational Meneurer Group into NATO's rear might be opposed by air interdiction or by fire from Army TACMS missiles, perhaps fired from one corps sector into another. This might compensate in part for NATO's shortage of mobile ground force reserves.

Within these overall approaches, there is some disagreement about which targets ought to be hit; that is, about what is the most effective way to delay, disrupt or destroy a given Soviet force element.

Some argue that the tanks are the most important targets. Others maintain that all the combat elements are important, and that concentrating on killing tanks, which is relatively difficult, is not necessary.

Some argue that disrupting command and control is the most effective way to stop the offensive. Still others argue that disrupting the Soviet schedule is the heart of FOFA, and that the most effective way to attack is to concentrate on creating chokepoints, which might also facilitate effective attacks on the forces themselves.

Finally, some believe that because timing is critical, what gets hit is not as important as hitting, for example, a command post, or a bridge, or a tank battalion just when the Soviets need it most.

Executing any specific concept involves several integrated steps, from initial target detection through kill. The operational realization of a concept ought to be viewed and treated as a package of individual systems, each of which has a different job. They all have to be there and operate if the concept is to work. Failure to procure one or more vital pieces might undermine the viability of the entire concept.

Within a package, there may be opportunities to choose among candidates for particular pieces, and possibly opportunities to save money in one part of the package by increasing capability in others. For some elements of the package, there may be only one viable choice.

A package for attack at 30 kilometers would be quite different from a package for 130 kilometer range. They would serve different but complementary purposes, and would not be directly substitutable. Congress and DOD might decide to buy one or the other, or both.

We make no recommendations for specific packages. However, the final report will compare the technological approaches for various pieces of the packages. We think the Congress should encourage the services to define and recommend specific total packages; for example, an Army package for attack with the TACMS missile, or an Air Force package for interdiction at intermediate ranges.

Cross-service concepts ought also to be examined. It is important to avoid buying several expensive systems without buying the other elements that are necessary to effectively underwrite a concept.

It is not sufficient simply to define a consistent package. The components of that package must be purchased in sufficient quantities. There are large numbers of potential targets; perhaps tens of thousands. While there is certainly no requirement to kill anything like all of them, the number that must be successfully engaged in order for FOFA to be successful is apt to be large. However, when determining the required numbers, it should be remembered that this will be an integrated NATO effort; U.S. forces will be required to do only part of the job.

Defining a consistent package of systems and determining how many of each component is needed appears to be a prerequisite for understanding how much a credible FOFA capability is likely to cost.

What might these packages consist of? Where do the deficiencies lie? And what is coming along to help? Complete concepts require: Surveillance and target acquisition; delivery platforms; weapons/munitions combinations; and the glue to tie all this together—for example, command and control, communications, data fusion, coordination, and identification, friend or foe [IFF].

Right now, NATO appears to be stronger in the area of delivery systems. If NATO is to derise the greatest benefit from the delivery platform it has, it will need improvements in the other areas.

It is difficult to go into the potential contributions of developments in these areas, especially surveillance and C-3, in open session. But let me offer a few general observations.

First, consider weapons and munitions. Warsaw Pact ground forces are characterized by masses of vehicles, many of which are armored. The present U.S. weapon inventory contains primarily weapons with unitary warheads and some dispensers of submunitions having varying degrees of effectiveness against armored targets. This could translate into a great deal of effort to kill a limited number of targets.

Furthermore, most of the air-delivered weapons require the attacking airplane to get close to the target, if not to overfly it, exposing the airplane to local defenses. Analyses show that the expected number of kills per round, or per sortie, could be significantly increased by building more submunition dispensers and making individual submunitions more effective. Smart submunitions carrying advanced kill mechanisms are of particular interest.

Putting submunitions on weapons that could be launched at some standoff from the target area could reduce exposure of the aircraft to defenses. Survivability could also be aided by developments in navigation and weapon control that allow the aircraft to spend less time searching for the target, or otherwise minimize its exposure to defenses. Many of these developments have applications to both medium and long range concepts.

The Army's TACMS missile will provide the ground forces with an autonomous capability to attack follow-on forces beyond the range of MLRS and artillery. This would supplement coverage by interdiction aircraft, especially in situations in which enough sorties are not available to cover the target set.

There will always be competing demands for interdiction aircraft—especially for multirole aircraft—and this competition is likely to be most acute early in the conflict. Factors such as attrition, damage to NATO's airbases, and weather can also reduce available sorties. The TACMS might also play a role in cross-corps support, extending the area of influence of ground forces beyond corps sector boundaries.

It would be misleading to tag most of these as "FOFA systems." They have wider potential applications, which ought to be taken into account when funding decisions are made. These include both wider applications within the context of a NATO/Warsaw Pact conflict, and other applications worldwide.

Two areas are receiving particular attention in considering the role of farther term developments: the survivability of the major components of NATO's FOFA capability, and the ability of smart submunitions to kill their targets in the face of Soviets' countermeasures.

## PREPARED STATEMENT OF DR. ALAN H. SHAW

Mr. Chairman, thank you for this opportunity to testify about OTA's study of technologies for implementing NATO's follow-on forces attack concept, which was requested by this Committee and the Committee on Foreign Affairs. With me today is Dr. Peter Sharfman, the OTA Program Manager for International Security and Commerce, who is supervising this work. We are accompanied by the project staff--Stephen Budiansky, Michael Callaham, Allen Greenberg, Peter Lert, and Nancy Lubin. With your permission, I may refer your questions to the individuals who have done the most relevant work.

As you know, we are about one-third of the way through our work, and have recently delivered a Special Report covering part of the tasks we were assigned. This Special Report discusses the programs that could improve the capabilities of the United States Army and Air Force to implement the follow-on forces attack concept. It also provides background material on the threat, the role of follow-on forces attack in NATO strategy, and operational concepts.

Follow-on forces attack--the acronym is pronounced "FOFA"-- was adopted by NATO in November 1984 as one critical mission component of the Alliance's conventional defense capability, one element of NATO's defensive response to a Warsaw Pact conventional offensive. As such, it is part of NATO's overall Flexible Response strategy. Having adopted FOFA, NATO now faces the issue of how to implement it. In particular, the U.S. and other member nations must decide what systems to develop and procure.

FOFA is, in simple terms, a concept for attacking those Warsaw Pact ground forces that have not yet reached the main battle area. NATO's attacks would take place from roughly 20 kilometers beyond the ground forces in contact to as far into Warsaw Pact territory as NATO's field commanders believe it can usefully be done. While the concept could be applied in any part of Europe, the focus is on the Central Region, where West Germany borders East Germany and Czechoslovakia.

Although the U.S. had a major role in the genesis of FOFA, it is an integrated NATO concept, and would be executed according to NATO procedures. In the Central Region, it would be applied across the entire front, not just in the U.S. corps sectors. U.S. forces would participate within their NATO roles. The Army might attack those forces threatening its corps sectors, and possibly support other national sectors through long range fire. U.S. Air Force wings would operate within integrated Allied Tactical Air Forces throughout the Central Region.

The idea of attacking follow-on forces is not new. What is new is the emphasis recently given to the concept, and the expectation that, by exploiting emerging (and recently emerged) technologies, NATO's currently limited capability to attack follow-on forces might be substantially improved.

Several months ago, Ambassador David Abshire, the U.S. Permanent Representative to NATO, wrote that one of NATO's critical deficiencies is: "insufficient means for defeating, disrupting and destroying enemy follow-on forces." There are steps that could be taken in the very near future to improve NATO's ability to use what it already has, but the greatest opportunities appear to lie in exploiting technology that is now fairly far along in the development process. Unlike ballistic missile defense-- which as OTA testified earlier rests heavily on technology only now beginning to emerge from the laboratory-- FOFA could exploit technology that is available now, and technology that is likely to be mature over the next decade.

While most of these developments are relatively mature, not all have been fully demonstrated; at this time we cannot say with absolute confidence that they will all work as advertised. Furthermore, it will be necessary to test complicated combinations of systems under realistic conditions before we can be sure that such combinations will really be useful.

In our Special Report, we were asked to provide an overview of the developments of interest. In doing so, we were led to the following observations. First, these developments only make sense in the context of operational concepts for attacking follow-on forces. Second, existing and proposed systems should be viewed in terms of complete "packages" for supporting the operational concepts. Third, the elements of those packages will have to be procured in sufficient numbers if the capability to attack follow-on forces is to be significant.

Operational concepts for attacking follow-on forces can generally be grouped into two major categories: operations at intermediate ranges; and operations at long ranges. These are distinguished by the types of targets and the assets that can be brought to bear against them.

Intermediate range is not precisely defined, but might extend out to roughly 150 or 200 kilometers beyond the ground forces in contact. The forces within this region would be either already committed to battle, or waiting to be committed in the very near future. In this region, NATO might seek to find those units that pose the most urgent threat, and delay, disrupt, or destroy them with ground-launched weapons or weapons delivered by tactical interdiction aircraft.

Recently, there has been interest in the concept of using long range bombers--such as B-52s--to strike deeper into Warsaw Pact territory against divisions being transported to the region of the offensive. This is a somewhat different concept. The targets would be in transit rather than preparing for battle, and therefore might be easier to find and attack. However, the effect of deep attack on the battle would be less immediate than that of attacks at intermediate ranges. In either case, penetrating aircraft would face Warsaw Pact air defenses.

The FOFA concept is still being developed. Within the overall guidance provided by SHAPE, approaches are being proposed, discarded, and refined. In our discussions, we have been able to identify several lines of U.S. thinking that, although somewhat different, are mostly compatible. The U.S. Army appears to have one perspective, while the Air Force has a somewhat different one. However, the services have taken a number of measures to coordinate their approaches. There are still other approaches, not so clearly associated with one service or the other. Our Allies may have different approaches that we at

OTA have not as yet explored. While all forces committed to NATO will operate as directed by NATO commanders, different approaches are likely to produce different procurements and different tactics.

The Army perspective is influenced by the ground battle they expect to be fighting, by the range of their artillery and MLRS, and by their AirLand Battle concept. The enemy forces within range of MLRS and artillery could reach U.S. forces in a few hours, and the Army will want to identify and attack the most threatening of them, targeting individual battalions or perhaps even companies.[1] Since they expect to be using a limited number of weapons in a "target rich" environment, targeting selectively will be important.

Air interdiction, a foundation of the Air Force approach to FOFA, is likely to extend considerably deeper into the enemy rear, where it is less likely that the intentions of individual battalions can be ascertained. Air Force targets will be regiments, or perhaps even entire divisions, selected after coordination with ground force commanders.

Thus, the Army and the Air Force would be doing somewhat different, but complementary jobs. An increase in effort by one could, at least in part, compensate for a reduction in effort by the other, but the two would not be interchangeable.

Some analysts view follow-on forces attack as a way to compensate for NATO's difficulties in quickly shifting ground forces to respond to Soviet actions. For example, a rapid massing of Soviet forces to break through a weak section of NATO's defenses or the insertion of an operational maneuver group into NATO's rear might be opposed by air interdiction or by fire from Army TACMS missiles, perhaps fired from one corps sector into another. This might compensate in part for NATO's shortage of mobile ground force reserves.

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[1] The Army has also been planning for the introduction of its longer range TACMS missile, which may require targeting larger aggregations, such as regiments and full divisions.

Within these overall approaches, there is some disagreement about which targets ought to be hit, that is, about what is the most effective way to delay, disrupt, or destroy a given Soviet force element. Some argue that the tanks are the most important targets. Others maintain that all the combat elements are important, and that concentrating on killing tanks--which is relatively difficult--is not necessary. Some argue that disrupting command and control is the most effective way to stop the offensive. Still others argue that disrupting the Soviet schedule is the heart of FOFA, and that the most effective way to attack is to concentrate on creating choke points, which might also facilitate effective attacks on the forces themselves. Finally, some believe that because timing is critical, what gets hit is not as important as hitting, for example, a command post, or a bridge, or a tank battalion just when the Soviets need it most.

Executing any specific concept involves several integrated steps, from initial target detection through kill. The operational realization of a concept ought to be viewed and treated as a "package" of individual systems, each of which has a different job. They all have to be there and operate if the concept is to work. Failure to procure one or more vital pieces might undermine the viability of the entire concept. Within a package there may be opportunities to choose among candidates for particular pieces, and possibly opportunities to save money in one part of the package by increasing capability in others. For some elements of the package, there may be only one viable choice.

A package for attack at 30 kilometers would be quite different from a package for 130 kilometer range. They would serve different, but complementary purposes, and would not be directly substitutable. Congress and DoD might decide to buy one or the other, or both.

We make no recommendations for specific packages. However, the final report will compare the technological approaches for various pieces of the packages. We think the Congress should encourage the services to define and recommend specific total packages--for example, an Army package for attack with the TACMS missile, or an Air Force package for interdiction at intermediate ranges. Cross-service concepts ought also to be examined. It is important to avoid buying several expensive systems without buying the other elements that are necessary to effectively underwrite a concept.

It is not sufficient simply to define a consistent package. The components of that package must be purchased in sufficient quantities. There are large numbers of potential targets--perhaps tens of thousands. While there is certainly no requirement to kill anything like all of them, the number that must be successfully engaged in order for FOFA to be successful is apt to be large. However, when determining the required numbers, it should be remembered that this will be an integrated NATO effort; U.S. forces will be required to do only part of the job.

Defining a consistent package of systems and determining how many of each component is needed appears to be a prerequisite for understanding how much a credible FOFA capability is likely to cost. A recent private study[2] has concluded that the necessary capability can be had at a relatively low cost. That contention, which OTA has not examined, raises intriguing possibilities. It implies that money spent on FOFA can provide a great deal of leverage. Critics of that study claim that such cost estimates are entirely wrong, that FOFA is apt to be very expensive. If that is so, it raises important questions regarding how much FOFA capability NATO can afford, and how much it should be striving to obtain.

What might these packages consist of, where do the deficiencies lie, and what's coming along to help? Complete concepts require: surveillance and target acquisition; delivery platforms; weapons/munitions combinations; and the "glue" to tie all this together--e.g. command and control, communications, data fusion, co-ordination, and identification, friend or foe (IFF).

Right now, NATO is strongest in the area of delivery systems. The armies have artillery, and several are buying the new Multiple Launch Rocket System. However, at ranges beyond about 40 kilometers essentially all capability resides with NATO's air forces. NATO has a large number of airplanes that can perform interdiction, but few that can operate at long ranges. Furthermore, it is important to keep in mind that these airplanes are the same ones NATO had before adopting FOFA. There will be many demands for their services.

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[2] Strengthening Conventional Deterrence in Europe (ESECS II), Westview Press, 1985.

If NATO is to derive the greatest benefit from the delivery platforms it has, it will need improvements in surveillance and target acquisition, in weapons and munitions, and in command, control, and communications ($C^3$). $C^3$ improvements include not only systems to move and manipulate information, but also operational procedures to ensure that everything that needs to be done can be done in a timely manner.

What are the major areas of development that are relevant for FOFA? They are:

1. The surveillance systems such as Joint STARS, PLSS, ASARS, and remotely piloted vehicles, as well as the tactical data fusion systems and other $C^3$ improvements that will support timely exploitation of the information collected by these systems;
2. The Army's TACMS missile;
3. Munitions developments, especially those aimed at producing multiple kills per weapon and those for killing heavily armored vehicles;
4. Systems that can increase the survivability and effectiveness of NATO's interdiction aircraft, such as short and medium range stand-off weapons, the F-15E, the LANTIRN, and other improvements in aircraft navigation and weapon control. Improvements in identification, friend or foe, would fall into this category.

It is difficult to go into the specific potential contributions of developments in these areas--especially those in surveillance and $C^3$--in an open session. However, let me offer a few general observations.

First, consider weapons and munitions. Warsaw Pact ground forces are characterized by masses of vehicles, many of which are armored. The present U.S. weapon inventory contains primarily weapons with unitary warheads and some dispensers of submunitions having varying degrees of effectiveness against armored targets. This translates into a great deal of effort to kill a limited number of targets. Furthermore, most of the air-delivered weapons require the attacking airplane to get close to the target--if not to overfly it--exposing that airplane to local air defenses. Analyses show that the expected number of kills per round, or per sortie, could be significantly increased by building more submunition dispensers and making individual submunitions more effective. Smart submunitions carrying advanced kill mechanisms are of particular interest.

Putting submunitions on weapons that could be launched at some standoff from the target area could reduce exposure of the aircraft to defenses. Survivability could also be aided by developments in navigation and weapon control that allow the aircraft to spend less time searching for the target, or otherwise minimize its exposure to defenses. Many of these developments have applications to both medium and long range concepts.

The Army's TACMS missile will provide the ground forces with an autonomous capability to attack follow-on forces beyond the range of MLRS and artillery. This would supplement coverage by interdiction aircraft, especially in situations in which enough sorties are not available to cover the target set. There will always be competing demands for interdiction aircraft--especially for multi-role aircraft--and this competition is likely to be most acute early in the conflict. Factors such as attrition, damage to NATO's airbases, and weather can also reduce available sorties. The TACMS might also play a role in cross-corps support, extending the area of influence of ground forces beyond corps sector boundaries.

It would be misleading to tag most of these as "FOFA systems". They have wider potential applications, which ought to be taken into account when funding decisions are made. These include both wider applications within the context of a NATO/Warsaw Pact conflict, and other applications world-wide.

OTA's work thus far has been concerned primarily with U.S. developments. However, several of our allies are also developing systems that could support FOFA. Armaments cooperation has become an important issue within the alliance. U.S. purchase of systems developed by our allies, co-production, and other sharing arrangements might prove beneficial.

Although the programs of primary interest for FOFA are those I have just discussed, I would not want to leave you with the impression that there is little or no role for technology now in earlier stages of development. Even if all the programs discussed above work out, analysts believe that problems will remain.

Two areas are receiving particular attention in considering the role of farther term developments: the survivability of the major components of NATO's FOFA capability, and the ability of smart submunitions to kill their targets in the face of Soviets countermeasures. Long range air launched missiles incorporating advanced guidance and other technology--such as the NATO Long Range Stand Off Missile--are being investigated as a method for improving the survivability of NATO's attack aircraft, both tactical aircraft attacking at intermediate ranges and longer range bombers attacking targets deeper in enemy territory. Most survivability programs are classified, and cannot be discussed here. Some are highly classified, and we at OTA have as yet too little information to evaluate them.

Thank you for your attention. The project staff stands ready to answer any questions you may have.

Mr. PRICE. Mr. Bennett, do you have any questions?

Mr. BENNETT. I want to thank all of the people who have come here today. I think you have made a very constructive group of suggestions. They are not all alike, but there doesn't seem to be much divergence or opposition.

One of the most constructive thoughts, I thought, was the idea of setting a figure, say $1 billion, which is, in the context of the other things we are doing, a modest figure.

Last year, this committee brought out legislation, and passed it, which set $1 billion for acquisition of conventional weapons that were already fully tested and fully available, to show that we were going to start a conventional initiative, and I think you ought to do that this year as well. And I would like to see it come out of this committee as $1 billion for R&D in the field of conventional weapons.

Now, in that package, I would like to see, if we can have it, things that would be symbolic and understandable. There are a lot of other things in R&D, but I think the public needs to grant the fact that you can do things for the infantryman and the man in the frontline combat that do require research, and are not all that theoretical as some of the things you have done, like AMRAM, MARIC, and things like that. There are some practical approaches.

He has mentioned the equipment you are carrying. As an ex-infantryman, I agree with you 100 percent. I am not sure how strong the substitutes would be, trenching tools and things like that, but if they can be made strong, you can count on it that that infantry soldier is going to double his capacity, because that weight is a weight that he has to carry with him all the time and it detracts from his mobility and it detracts from his ability to carry ammunition. That is an understandable thing, and I think that is something we ought to look at—whether we can make strong enough things that will be much lighter, because as an ex-infantryman I think that is a very worthwhile suggestion, and it is understandable.

The public will understand that effort, and I think that is the sort of thing I would like to see in this billion dollars.

Now, in the field of the torpedos you referred to, I didn't realize that there hasn't been adequate testing since 1948; but there hasn't been adequate testing. That is another thing, Mr. Chairman, the field of adequate testing. If there has been any real revelation outside of fraud and abuse in the waste of money in the Federal Government, I think it has been the fact that we have not adequately tested. That has sort of slipped through our fingers. It gets beyond us.

We are already in production. Nobody wants to stop it. And it costs money to do it. It would save a lot of money if we early on decided to do away with something that was not the best thing to do.

I feel that is an area, if the 1948 is something, that might be a symbolic thing to look at the torpedos, particularly since you suggested testing it against NATO torpedos, which is another thing we ought to look at.

We ought to look at how we can cooperate with our allies, and become us, instead of them and us. It is important that we do that, and they will appreciate it and we will appreciate it as well.

Another thing you talked about—and I am not quite sure you answered this—but I would like to see myself better close in support for the infantry than is now provided. I don't think it is very adequate. I am not sure about the artillery thing. You know more about artillery than I do. But, of course, artillery has been with us for hundreds and hundreds of years, and actually the type of gun you seem to be thinking about is something that we probably had 200 years ago, except it is better today.

It didn't go very far in ancient days. The artillery in the Revolutionary period was a piece that didn't extend very far in distance. And, as I understand it, that is the sort of thing you are looking at.

The only thing I would really like to emphasize, I would like to have each one of you, if you would, submit in order of priority the things that you think—that if you had $1 billion, you would spend for pushing the conventional war to a greater success, the priorities you would list for various things, keeping in mind, if you can, to make it sufficiently visible so people out there can understand it, because it is important that they understand that this Congress and this committee, this subcommittee, and this full committee, are tackling this problem, because we have been told by General Rogers it is a disaster, what we have today.

We are not paying attention as we should to conventional weapons, and we must make this progress. I would like to see every year for the next few years some sort of thrust like that. I don't think it has to be a lot of money. A billion dollars in the context of the overall bill is not a lot of money, and you picked out the things you really felt like you could make progress on. Then, the infantry soldier, of which I was once one, will feel like, thank God, somebody is finally looking it up.

I haven't any questions to ask, except one or two. How about the long-range aircraft C-17? This has to do with heavy lift potential, short front wave. Is that a valuable weapon that we should go to, or is it not? Has anybody studied that here that is an authority on that? Do you have a feeling about it?

Mr. SPREY. I would like to at least comment briefly on that. There is no question that of all the airlift missions we have, the most neglected is forward area airlift. By that, I mean airlift to units well below division level, that is, supplying regiments and battalions with emergency supplies through airfields that are muddy, sandy, dusty, unpaved, rough, et cetera. As the years go by, every year we have less and less capability in this vital mission area.

In Vietnam, at the beginning of the war, we had a C-123, a small twin-engine transport that could do a reasonably good job flying into dirt strips and rough terrain. By the end of the war, we had unloaded the C-123 because it was very unpopular in the Air Force—too small, too unglamorous, too old.

The best we could do at the end of the Vietnam war was the C-130. That is already a very large and pretty expensive piece of equipment to be flying into a battalion-level dirt strip.

The C-17 means we are abandoning the goal of supplying forward area troops. This is because there is no way you can take an airplane of $100 million-plus and risk it flying into even a division level airstrip, because there is a very good chance that you will have a few mortar teams or something within range of the airfield, and every now and then you will lose $100 million against one $50 mortar shell.

Even worse is the fact that the other mission the C-17 is supposed to do—intercontinental airlift—it doesn't do well, either. It does it substantially more poorly than a C-5, which in turn does that mission much more poorly than a commercial 747 freighter. So the C-17 represents one of those terrible multimission compromises that weakens our ability in strategic airlift and essentially eliminates our ability to resupply forward troops.

Mr. **Bennett**. How do you feel that they could then get the large type of equipment to the frontline? What would be your suggestion as to how you get it up there? Do you think it doesn't have to be flown?

Mr. **Sprey**. I think if you are talking about large equipment, you can't fly tanks down to a battalion-level air strip. You are just going to have to give up on that.

There are some awfully important things you want to fly in there, like bullets, when you are out of them, or medicine, or spare parts, and stuff like that. We do not have the capability to do that today, except by heavy lift helicopters, which have relatively limited range, and some real problems as to the mobility of their basing. I think forward area emergency airlift is a very important problem and one that can be solved with commercial short takeoff airplanes. I think this is an area where the deeper we get into specialized military airlift airplanes, the worse off we get. In fact, the right way to approach this problem would be to compete some commercial short takeoff airplanes, possibly modified to fly into rougher fields than they do today, and see which ones do the battalion job best.

Mr. **Bennett**. Did you want to add something there? Apparently not.

I don't have any further questions.

Mr. **Price**. This question probably should be directed to the panel. We have spent billions of dollars during the course over the last 5 years. Yet, the conventional story is always the same. We can only last a few days.

We all agree that the professionals have been misguided?

Mr. **McCurdy**. Did you hear the question?

Mr. **Rosenbaum**. Could you repeat it?

Mr. **McCurdy**. He basically said that we spent $1 trillion in the last 5 years, and the question is whether or not we have misspent or misguided that expenditure in the area of conventional systems.

Mr. **Price**. Another point. We always say that we are going to last only a few days. That is the big point on that.

Mr. **Rosenbaum**. It is too easy to say that the money has been misspent. It is too easy to say that service bureaucracies have dominated the choice of platforms. It is too easy, in my mind, to say that Army people buy tanks because it is more fun to drive tanks, and Air Force people buy airplanes because it is more fun to fly airplanes.

The problem is terribly, terribly complex, and the adversary is a guy who really seems to be drawing from an infinite resource of money. He is building equipment. We have no idea what the Soviet Union will do with the huge amounts of tanks it has in storage. In fact, probably the biggest problem the Soviet Union faces is similar to our problem in the Wheat Belt: what to do with all the extra tanks.

I mean, the Soviets have a modern machine that develops an enormous amount of equipment. What do you do against it? How do you fight a battle, especially one on a piece of paper, that pits you against, what, 30,000 tanks? It is like trying to develop a survivable missile against 14,000, 15,000, 18,000 warheads.

So, it is too easy to say, Mr. Chairman, that we have wasted or misspent the money. What I would prefer to say is we have to redirect our efforts now, to manage that United States/Soviet competition in a way that takes more advantage of those things that the West does best.

We need really to take advantage of the technologies that we have developed, and take advantage of them in a way that is slightly different than that we have done before. We have a time scale of about 10 years, if we are lucky, from weapon concept to weapon deployment. The weapon that we then build is so big and expensive that it usually lasts 20 or 30 years. So, when we are in a concept development phase right now, we are talking about weapons systems that are going to be with us for two, three, four decades—the M-1 tank, the MX missile, the B-1 bomber, the ATB, the SSN-21, if we build it.

We have a tendency to get ourselves caught in a trap of saying we have got to build this system so that it lasts forever and it fights whatever threat we can think of fighting for 20, 30, 40 years. As a result we freeze ourselves into a design that is overspecified, overcomplicated, too big and too expensive, and that stands no chance of defeating a threat for 30 or 40 years. I mean, it is impossible to do that.

What we need to be able to do is get ourselves into the mindset of deciding that a piece of equipment needs to go out of the shop, needs to come out of the building, out of the Congress, out of whatever it is that gives birth to pieces of equipment, in some given time scale, and it has got to be the best we can do. It has got to be effective, as effective as we can make it, and as robust as we can make it. And we must recognize the fact that right after that piece of equipment comes out we need to fix it. We need to recognize the fact that as soon as you put a Stinger out in the field, as soon as you put any IR seeking missile out in the field, somebody is going to put a flare out as a countermeasure. And before he gets a chance to put a flare out, you had better have on the drawing boards the next generation or the fix for Stinger, as we do.

But if we are going to always wait for that ultimate solution, then we are going to spend trillions of dollars and we are going to still be faced with that situation of 2 or 3 days conventional defense prior to nuclear release. That is philosophy, and it is hard to pin down, but it is a mindset that we have got to develop.

By the way, I believe that we have got to develop that mindset both in the Congress and in the Department of Defense. I don't think the problem is simple enough for either body to handle by itself.

Mr. McCurdy. I would follow up on that point for just a moment. The emphasis in this country, though, apparently, has been on—you said it is too easy to say Army buys tanks because they drive them, and it is too easy to say the Air Force buys airplanes just because they fly them.

Is it not true that the emphasis on perhaps technology and overspecification has created this monster that is unable to fight, and certainly doesn't address the critical shortages?

Mr. Rosenbaum. I agree with the second part, the emphasis on overspecification. The emphasis on technology I don't necessarily agree with.

Technology isn't a bad thing. The problem is usually how that technology is implemented into a system. If the system becomes just so awfully complex that nobody is going to be able to use it, or if it is too expensive, we often blame technology rather than the way requirements were developed to implement the system.

Mr. McCurdy. Perhaps I should have said the leading edge of technology, that last 5 percent, that last performance.

Mr. Rosenbaum. If you try to squeeze that last piece of performance out of a given system, you are absolutely right. Somebody once drew a curve and said that you reach a point in an airplane—and I think it was the B-1 bomber—where adding one additional pound of payload would double the cost of the airplane. You reach a point of diminishing returns, and whether that point of diminishing returns is at the 95-percent or the 85-percent level we are both saying the same thing.

We have to understand that need to put systems out that don't reach for that final last bit. We can't afford it.

Mr. McCurdy. I would agree with that.

I would like to say also, by the way, before I have to leave here, that I agree with Mr. Bennett that we have not placed enough emphasis here and that additional capabilities are incredibly important. The problem is, too, though, it is going to cost us more. I mean, if you are talking about the things, you are not going to reduce the defense budget by putting the stress on conventional versus strategic. And even though I agree that you have to do that.

The point I want to raise, though, the gentleman from OTA that was talking about the packages, part of the problem that we experience here and that you have been advocating for years, and certainly recognize—and I think the Packard Commission has really addressed that—and that is especially in the R&D areas, defining exactly what the mission is, and looking at the theater of operations as opposed to the individual services, looking at trying to find out what the threat is in a given area, and design the weapons system to meet that threat within that given area, as opposed to just the Air Force has to have so many fighter aircraft, et cetera, et cetera.

The question I have I think really gets down to specifics, such as the F-15E. This member has a hard time understanding why we want to take an air-to-air or air superiority aircraft at $30 million to $40 million a pop, and retrofit it to make it a deep interdiction aircraft that has a cross-section bigger than a B-1.

Is it realistic for the United States to spend that kind of investment for that particular mission, with the limited budgets that we have? Can any of you on that panel stand up and say you think the F-15 is performing a mission, the most cost-effective mission? Does anyone want to venture on that one?

Mr. **Braddock**. I will be glad to try to answer that question for you.

You folks have heard quite a bit over the last 2 or 3 years about how you might do interdiction with missiles, with aircraft, and so on. You have been shown what our allies have developed. Toronado is an example, it is sort of a class aircraft you are talking about.

If you decide that you are going to have to send aircraft in, there is no way to send a cheaper aircraft in that far. It has to be able to penetrate. It has got to be able to carry a big payload.

So, the real issue is if you are going to send aircraft in, it has got to be a capable aircraft. You are going to end up paying quite a bit of money for it. If you try to send in an aircraft that doesn't have much in the way of carrying capability, doesn't have the ability to fly low and fast, doesn't have the ability to suppress defenses in a variety of ways, you are not going to make it.

Now, the question you have to ask yourself is: Do you need the complementary means to do the job? Do you need aircraft, and do you need missiles? Well, when you look at payloads that you can carry, and when you look at the theaters in which we might operate, the prudent answer that comes back is we want both. That is the prudent answer.

If you choose one, you are taking some risks. The reality is, we bought it on the cheap for so long with nuclear weapons, that when we are now faced with the fact that we are trying to buy real conventional combat capability, it is expensive. And then when you try to buy, let me call it, very reliable combat capability that comes from having a mix of aircraft and missiles so the other side can't plan just to intercept one kind of thing, it gets more expensive.

The real question goes back to the words Harold was using before: Is it going to be robust? The services are going to recommend, because that is their business, robust solutions. And I believe that you folks in Congress don't gamble very much on chancy solutions, and I think in the end you are going to back them when they convince you that you need an expensive airplane to go deep.

You are going to go 200 kilometers. It is an expensive machine. Our allies have proved that. The Soviets have proved it. We are on the verge of proving it ourselves.

Mr. **McCurdy**. I think one question might be—you know we have the F-16. We are buying those in droves. Is that not a more capable answer to that mix? The reason it is designed to be a lower cost of the mix——

Mr. **Braddock**. It is lower cost.

Mr. **McCurdy**. Yes; or does the Toronado perform that function? Does it have to be ours?

Of course, some who would be perhaps more cynical than myself would indicate that our desire to keep a production line open on the F-15 is a big driver in that decision.

Mr. **Braddock**. I think that may be a factor in it. But I don't think it bears on the discussion of the technical matters.

Mr. **McCurdy**. Right.

Mr. **Sprey**. Can I offer a different view on that same subject?

Mr. **McCurdy**. Sure.

Mr. **Sprey**. Let me start first with the smaller subject of designing interdiction airplanes. I worked a great deal on design of airplanes. I led the Air Force technical team that did the design concept for the A-9 and A-10 flyoff. I worked with two Air Force officers to start the light-weight fighter that became the F-16.

Let me tell you that nothing in the world could be more wrong than the idea that, just because you go far, you have got to be expensive. The F-16—you raised the subject of the F-16—is an excellent example. Very few people even to this day are aware that the F-16, at half the weight of the F-15, goes at least 50 percent further. Range is far from proportional to weight, and certainly not proportional to cost.

There are other factors that swamp those two. If, in fact, you were to design an airplane to do interdiction bombing, as best as it could be done, if you sat down and looked at the combat circumstances of how to bomb in the suburbs of Warsaw, you would not design anything close to an F-15.

The F-15E is a disastrous approach to bombing deep into Poland. It is a grossly unsurvivable airplane. With the weight we have put on it, its maneuverability and ability has been badly hurt, which hurts its survivability. Further, it is so thin-skinned that any .22 rifle can shoot it down. That, of course, is also true of the F-16 and any other high-performance 450-knot fighter we have. None of those would represent the way we would approach building a good interdiction airplane if combat effectiveness were our highest priority.

I would suggest that, as a historical example of how to build a better interdiction airplane, and one that came out remarkably cheap, we look at the history of how the A-4 was built. The A-4 is the work of one very brilliant aircraft designer, Mr. Ed Heineman, who worked very closely with the Navy. The Navy wanted that airplane, in fact, for nuclear interdiction. It was intended to be an airplane that was to operate off the small carriers of that time, to fly a relatively long distance, several hundred miles, and drop a nuclear weapon.

The Navy air bureaucracy's specifications had led to an airplane of 30,000 pounds, because of all the combat-irrelevant junk they put on it. Mr. Heineman, sitting in a hotel room in Washington over a weekend figured out where the unnecessary junk was, pared it out, designed on the back of an envelope a 15,000-pound airplane, and fortunately found an admiral who saw the sense of having a far better 15,000-pound airplane than this 30,000-pound plane that the Navy bureaucracy put together. That stripped-down airplane became the A-4, which was the most survivable and lowest cost interdiction airplane that we flew in North Vietnam. As a microcosm of the whole national defense problem, that is not a bad example.

Everybody here seems to be agreeing happily that conventional is expensive. I would like to beg to differ. We have made conventional so expensive that we have no conventional capability. I do not think there is anything inherent in fighting conventional war that requires $3 million tanks, $50 million interdiction airplanes, et cetera. In fact, I would like to go one step further and say the extra cost that we have placed in the $3 million tank and the $50 million interdiction airplane harm their effectiveness in profound and fundamental ways.

It is not that we have diminishing marginal returns, as the economists like to think. We have negative marginal returns. Every extra dollar we stick in the F-15E, every extra dollar we stick in the M-1 will lead to more Americans getting killed, because in fact those extra pieces of unneeded equipment will help, ruin combat effectiveness.

I would be willing—I would be very happy to demonstrate how the present defense budget, without any increase at all, could be used to support forces at least 50 percent larger than we have. Within the same budget we could probably double the production of weapons, and at the same time have weapons that are individually more effective than what we have today.

Mr. McCurdy. The gentleman from Florida is talking about $1 billion in this year's budget for the F-15E is what? $1.8 billion. Here is a witness that says it is absolutely the wrong mission, the wrong aircraft for that mission; that, in effect, takes from that. That is just one weapons system, just one weapons system, and yet for us to stand up and say we are going to eliminate that amount in procurement, it is impossible.

I bet I couldn't get a dozen votes in this committee of 45 or so to eliminate the F-15E, and I am sure Ronald Reagan would get up there and say "I am siding with the communists" or something. That is absolutely crazy. But this is the attitude that has built up. Plus there are a lot of manufacturers out there that have other systems.

Tom Cooper, Air Force Assistant Secretary, said, well, you know, keeping the mission line open is important, too. Well, sure, we would like to be able to keep it all open, but why not go to another mission area? Why don't we go to that next generation of whatever for a lower cost, if deep interdiction really is the mission, and maybe you guys ought to say whether or not that is the most important mission, or should we be addressing that as much as we appear to be. We have got TACMS, some of the other things.

Go ahead.

Mr. Sharfman. I have a couple of comments.

First, one of the things that we could certainly do to improve the effectiveness of what we have is to think in terms of a package. We shall be sure that when we buy a very expensive platform, we buy enough ammunition and good enough ammunition to go on it.

Pierre Sprey said that we focus too much on submarines and not enough on torpedos. I don't know whether that is true or not. What I do know is that the F-15E would be an awfully expensive airplane to carry relatively unsophisticated and ineffective weapons. It would be a very expensive airplane to build if there were not enough weapons, enough bombs, and enough air-to-surface missiles in stock to put that expensive platform to use.

OTA has found, as we have looked at the range of systems for the FOFA mission, that generally speaking there is an awful lot of money already spent, and more money being proposed to be spent, for the platforms, and relatively less money being spent for the things that go on the platforms—that is, the weapons, and the munitions. There is a trend now to spend money on the C-cubed, which is very important, but that is a relatively recent trend.

If you look at what is actually in place, the C-cubed has been a little short-changed, as well.

Mr. McCURDY. Can you think of or give other examples like the F-15E? I mean, the F-15 is one. Again, you are talking $2 billion a year. So that is just one platform which I question.

Are there any other systems where you see would be close to being termed a gross misallocation?

Mr. SHARFMAN. I didn't say that the F-15E was such a gross misallocation.

Mr. McCURDY. I don't know whether it is or not.

Mr. SHARFMAN. I am only saying that if you buy it, you ought to buy weapons to put on it.

Mr. McCURDY. I understand. I will say that. You don't have to say that. You can nod. You don't have to be on the record.

The point is that there are some other examples, I am sure, out there where we have put too much emphasis either on the platform, or the platform that wasn't designed for that in order to keep the line open.

You wanted to say something?

Mr. ROSENBAUM. Yes; I would like to lend my support to the notion that there is a poor balance between platforms and munitions.

I would note that we have a single smart submunition in FSED at this time; one single first generation submunition. That is all.

Mr. McCURDY. Is that SKEET?

Mr. ROSENBAUM. It is the Air Force version of SKEET. Sadarm has been around for years. TGSM has been around for years. But we have one single submunition that we think will come out of the pipeline in 2 or 3 years. There is something wrong with that kind of balance, and that needs to be addressed.

With respect to the difficulties you have with the F-15E, if you think it is difficult on this side of the river to cancel a program, can you imagine how difficult it is on the other side of the river to cancel the program? Running a $300 billion business, which the Department of Defense is, is not an easy task at all. It is a very difficult task.

Getting the kind of consensus views that I think is coming out of some of the discussions we are having here, that is the need for some sort of an umbrella approach to the conventional defense programs, seems to me to be very useful. I think that will help us all to develop the system of systems that we like to think is going to give birth to some real weapons.

I would also like to emphasize what Dr. Braddock said. The Department of Defense went through a very, intensive review process in the past year, and came out with some substantive recommendations and some substantive programs, which are contained in the Defense Science Board's report on the armor, antiarmor competition. I highly recommend that the committee request either the study itself or to have the results of the study presented.

One last area where I find myself in strange agreement with the gentleman to my right. It is really a subject that I did not even think would come up during these proceedings, and revolves around Soviet submarines. Although I find it highly unlikely that we could afford to design two new U.S. submarines and to compete and fly off two new U.S. torpedos, I really am convinced that in the decades to come the Soviet submarine threat will pose one of the more significant threats we face in defending Europe. When they turn their attention to SLC intervention—their capabilities in terms of numbers and diversity of platforms and weapons, could be very significant. We need to start worrying about that now.

Mr. McCurdy. I will recognize the gentleman from Georgia.

But why is it that we haven't developed—you mentioned an antiarmor system at the infantry level. Is there a technological hurdle there? Why have we not replaced the bazooka of old?

Mr. Sprey. There obviously is no technological hurdle since France, Germany, Sweden, Russia, Israel—and I could go on and on and on with a long list of countries—all have somehow managed to overcome that technological hurdle.

No, the hurdle is purely a bureaucratic one, and it shows you how long these bureaucratic problems can last in essentially unchanged form, and how many thousands of Americans have to die for lack of resolution of those problems.

Mr. McCurdy. Does it have to be 25 to 30 pounds? Isn't that our requirement?

You talk about specifications requirements. Is that the thing that drives that?

Mr. Sprey. No. The problem we have had in the past is that the U.S. Army bureaucracy that has been involved with developing these weapons—a bureaucracy which has gone through about a dozen name changes since 1942, but is father and son pretty much the same as it was then—likes to produce weapons with ineffective, puney warheads, for reasons that I don't understand completely, except the bottom line is very clear:

Every time we come out with a new unguided antitank weapon, it fails to stop the enemy's tank, because the warhead was too small. That was true in 1942 with the 2.36-bazooka in World War II; we were still stuck with the same bazooka in Korea. We had totally failed to field a beautiful antitank weapon design that we had in hand before the beginning of the Korean war. This was the 3.5-inch rocket, actually a German design, and of course we failed to field it because it was German and not American.

The Army bureaucracy was forced to field it, because a scandal broke out at the beginning of the Korean war when our troops were overrun for lack of a decent weapon. So we hastily fielded the 3.5-inch, which was 50-percent larger than the bureaucratic solution. The Army got rid of that fine weapon just as quickly as they could, and reinstituted an inadequate weapon, called the LAW, light antitank weapon, which was back to the 2½-inch class. That failed us miserably in Vietnam. It led to the deaths of a lot of allied Vietnamese soldiers and a fair number of U.S. soldiers, when it couldn't even stop Soviet light tanks so flimsy they could be penetrated by a .50 caliber bullet.

After Vietnam the Army's solution to that was a disastrous R&D weapon called Viper, which has a puny 2¾-inch warhead. This, fortunately, was stopped because of the Congress, but only after 10 years and hundreds of millions had been wasted.

You see, I think the lesson here is there are certain weapons developments that are so vital that, no matter how often the Congress gets accused of micromanagement for intervening, they simply must intervene when the Army fails to provide our soldiers what they most urgently need. The rifle is like that; so is the shoulder-fired antitank weapon; just too many thousands of American lives are tied up in these vital weapons.

We are now at the stage of fielding something called the AT-4, which came out of a comparative test that was forced on the Army by Senator Rudman—unfortunately, a test that the Army made a mess of. The AT-4 is a Swedish weapon. At this point, it looks like it might be somewhat better than the LAW and the Viper that it was competing against.

On the other hand, we haven't the foggiest notion of whether the AT-4 will stop a Soviet tank, because the Army to this day has not fired it at any one of the hundreds of T-55's, T-62's or even T-72's available to us to test against, which brings us right back to where we were in 1942. We refused to fire test bazookas at captured German tanks back then and consequently, squandered the lives of thousands of our soldiers.

That problem is basically what I am trying to address in the very first item that I put up in my list of things that the infantry needs. That first item is to do a real live fire test against real enemy tanks, comparing those NATO weapons that work against the weapon that we are proposing to buy, the Swedish AT-4.

Mr. McCurdy. Thank you.

Mr. Darden.

Mr. Darden. Thank you, Mr. Chairman.

Mr. Chairman, first of all I want to apologize for my not being here earlier, to you and to the panel. In the Readiness Committee, Under Secretary of Defense Taft had already agreed to be our witness, and I had made a prior commitment to be there.

But I have reviewed your statements and I appreciate very much your being here today.

Mr. Sprey, I want to point out to you, as you may know, that in this year's DOD budget the administration has requested $612 million for further R&D for the C-17. I was informed of your assessment of the program a little earlier, and it concerned me quite a bit.

I wonder if you have had a chance to study the Heritage Foundation report about the C-17, or have you had a chance to look at the study by the Congressional Budget Office of this program, which generally reaches the same conclusion that you do, that it is a program that frankly we don't need; that it is a very costly expenditure of taxpayers' dollars for which we won't really get any significant improvement; and that the notion of bringing this aircraft valued at $150 million to the frontlines frankly won't happen.

Have you had a chance to review those studies?

Mr. SPREY. No, I am sorry to say that I have not read either of those two studies. I base my statements on having reviewed the C-17 design and on having done a lot of work on analyzing C-5's, 747's and C-130's.

The first year I spent in the Pentagon I worked full time on the subject of intratheater airlift and how best to provide it to forward troops. I have extended my work from back to modern airplanes as the basis for what I have said.

Mr. DARDEN. As a long-time opponent—that is, long-time ever since I came to the Congress opponent—of the C-17, I have shared some of the frustrations that some of you have mentioned about a program that, once it takes on its own life, it can't be killed, because the rationale seems to be\if we have got $50 million in it, then we have got to keep going until it is $100 million, until it is $1 billion, and so forth.

How do we—and we are talking about conventional defense initiatives, planning and long range—how do you go about—and I am not asking this question in anything but all seriousness—how do you go about terminating a program in today's environment?

Mr. SPREY. I am not an expert on how to create congressional alliances.

Mr. DARDEN. We are accused of micromanagement. If we allow it to go on—I am just expressing my frustrations. If we allow something to go on, then we are ignoring the issue.

Mr. SPREY. That is right, and unfortunately that makes Congress a partner in the general decay of our conventional defense capabilities. Allowing things like the C-17 and the F-15E and other weapons that are so harmful to the conventional defense capabilities we need—allowing those to continue means in essence that the Congress has become a partner in the decay of very badly needed combat capabilities.

Mr. DARDEN. We prosecutors would use the term "accomplice," I suppose.

Thank you very much.

Mr. Bennett.

Mr. BENNETT. You have certainly given us a lot of food for thought here. I used to be an antitank officer in World War II, and I am really kind of distressed at the muddle I see in the approach to antitank weapons, and apparently you are as well.

You mentioned some very innovative ideas. I never thought about the possibility of using motor vehicles, but it has some appeal to me, because the thing that distresses me about the Bradley is the tactics. In other words, having a highly vulnerable in-tanks group of people and a wonderful target it seems to me is about the last thing I would ever want to have on the battlefield, and individually walk the things or some other way to get there fast, even in an open truck, and then disperse them seems to me to be a better thing, thinking about your own son being in a Bradley, and we have to think about all these people as being our sons.

That has to do with victory, too, as well. There is no value in killing people on your side. I think we ought to look into that, and I appreciate your bringing it up.

I would like to say I think I have a solution to some of these problems. I am an old-time politician. I have been in politics most of my life. I think you can see things coming down the pike that sometimes can help you, and one of them is the word "competition," and the other one is testing.

Well, there isn't any real point in saying that a bayonet isn't good. You can have a better bayonet, if you are not going to buy it anyway. Or if you are going to have it, if there is not great improvement you can make on it.

What is the debate? It is not a very great weapon. It doesn't have to be the same weapon, but has the same purpose. For instance, a missile versus deep interdiction airplanes, they are competitive for that particular objective, or maybe even artillery. They are competitive. So you could have testing in competition, and that is what I would suggest we do.

I would suggest this subcommittee come out with some required tests in competition between things which are designed to use in similar objectives. Believe you me, if you have those tests and they are fair and they are well done, at the end the Congressmen can't resist. In other words, there is no way in which parochialism is going to make a majority of the Members of Congress support a weapon which is obviously inferior to another weapon.

So, what we need to do is throw more light on it. We need to throw light on it more quickly. And we need to have it in competition with other things.

We don't need these layers on layers on layers of weapons to have the same objective. In the first place, not all those infantry guys are all that brilliant. We master one gun or one particular weapon, and we are not that anxious to have another one which requires more than we are innately born with.

Some of the best infantry soldiers that we have ever had, some of the greatest heroes we have ever had in this country—not people who passed high IQ tests, and I am speaking as an ex-infantry soldier myself, and I don't think I would pass with a very high IQ test, but I think I was a pretty good soldier—and I think we ought to do the best we can to keep infantry weapons as modern as we can.

The real thing I am trying to get down to here is this: It was asked how do you turn it around. The way you turn it around is you have competition in testing, and you test systems against this, and I think you can win it. But it does take courage to bring that out, because there will be pressure on Members of Congress not to have that competition. But we ought to have it.

Everybody has said we ought to have more tests, and we know it ought to be realistic tests. Everybody said we ought to have more competition. Even the Packard Commission, more competition.

There is the answer to it, and if the facts all come out there won't be any parochialism.

I appreciate very much your being here. You men have given all this thought to this. I really hope you do what was suggested a moment ago and give to the chairman of the committee and myself, or to both of us, a list of things, not only a list of things you think are priorities, if you are going to put them in, but if you can pick out some that you would like to leave out, because we are going to have to leave some out in order to get some. If you would give us a list that you don't think are that hot, I would appreciate it.

Thank you very much.

Mr. DARDEN. Thank you, Chairman Bennett.

I was very interested in his observations about the IQ situation. I think it is probably true of Members of Congress, too, when we get right down to it.

Gentlemen, before we close I think Mr. Battista had a question or some observations.

Mr. BATTISTA. Yes.

The chairman talked about this $1 trillion in expenditures, and the fact that the bottom line is still the same. Let me get a little more specific than that.

It was in 1982, I believe, when Weinberger talked about emerging technologies, and at the time General Rogers said that "I have got a tripwire strategy in effect; that with what I have got in Europe today, after 3 days I have two choices. I could theater nuclear or I give up."

OK. We have spent $1 trillion since that time on defense, and I was in Bucom about 2 or 3 weeks ago and guess what I learned? The tripwire strategy is still in effect; that after the second or third day they either give up or they go theater nuclear.

Well, one would wonder then how you would come to any other conclusion other than our appropriations for conventional defense have been misguided.

Is there general agreement, without being specific, that we haven't been responsive to the requirements of our operational forces, the user? I see one head nod.

Mr. SPREY. I certainly agree.

Mr. BATTISTA. Joe, do you agree?

Mr. BRADDOCK. I think that is generally true. And if you look at the way in which the resources have been spent, it is not too surprising that that result is obtained, because it takes time to get momentum into programs.

When you ask how much combat capability have we increased, let's say in Europe, it is certainly not $1 trillion worth of combat capability.

Mr. BATTISTA. Just take the conventional part of that budget. It is not even that, is it?

Mr. BRADDOCK. It is probably 5 or 3 percent of that total.

Mr. ROSENBAUM. Right. It is only a small percentage of the $1 trillion that went to the combat capability.

Mr. BATTISTA. What I am saying is, whatever that percentage is, after 5 years, if the bottom line hasn't changed, something is obviously awry.

Mr. BRADDOCK. Wait a minute. Let's look at the balance.

On the other side, let's just take the Soviets. The Soviets are modernizing their ground force at a rate which is about equal to the size of the United States Army, every year, and is modernizing the tactical air force at a rate which is about a third the size of our tactical air force, every year.

Now, the rate at which we are modernizing is substantially lower than that. In a competition like that where the numbers aren't going to favor us we have to make exceptionally smart decisions about how we are going to modernize to keep that thing relatively in balance, or it is going to get away on us.

**Mr. BATTISTA.** Hasn't it, in fact, gotten away on us already?

**Mr. BRADDOCK.** In some areas, it definitely has gotten away from us. In the heavy armor, antiarmor business, we have let it get away. And, I think, the measures that we are now attempting to put in place I hope will work, because they are relatively extraordinary. You will hear DARPA coming over to you to explain a substantial program they are starting in parallel with what the Army and Marines are doing, and it is needed.

**Mr. BATTISTA.** Excuse me for being pessimistic, but normally everything DARPA has ever started that was worthwhile was viewed by the services as not invented here, and it went away.

**Mr. BRADDOCK.** This time I have my fingers crossed, because it appears that both the Army and the Marines, the staffs at least, are in cahoots with them.

**Mr. BATTISTA.** Alan.

**Mr. SHAW.** I just wanted to offer a couple of comments on what you have said. I heard General Rogers make the same statements, followed by a statement that a basic reason why this is so is lack of sustainability. And it gets back to this issue that we have been talking about here, about balance.

Where is the money being spent? If there were not enough things to be shot out of systems that we have, 5 years ago, and there aren't enough things to be shot out of the systems that we have now, that says something about the patterns of procurement.

I mean, the modernization is there. We have seen the modernization going on. I think we have to look a little more deeply into the cause of that.

**Mr. BATTISTA.** Let me ask you something. We can't meet the threat today, which is quantitatively superior to ours, to our forces, with $200,000 a copy air-to-air missiles. And what do we have on the drawing board? A $750,000 a copy missile. Or, if you want to take the Air Force number, a $480,000 a copy missile. So, if we have less than one aircraft load out of air-to-air missiles today that are half the price, and the threat now acknowledged by everyone that I have spoken to is getting qualitatively better, then how in God's name are you going to change this profile by building things that are more expensive?

And I might point out that the last qualitatively superior nation, the last technologically superior nation to lose a war were the Germans during World War II. And so I mean this balance between quality and quantity, I think, certainly has to be brought into better perspective.

Now, let me just make one other observation and see if I can get agreement out of you folks. We have got an F-15, and it has an ALQ-135 jamming pod in it. We have an F-14 with a 126 jamming pod in it; an S-16 that is going to have SPJ's, or 131 jamming pods in them. We have a 111 and that might have a 189-jamming pod. These are all going against the same spectrum of surface-to-air systems.

We also have a couple of dozen inertial NAV systems, all expected to a nautical mile an hour. We also have a dozen or so radar warning receivers.

I had five different ways of communicating with tactical aircraft like JTIDS, ATDMA, a Navy DTMA. There was a half-quick, an INEWS on the drawing board—I am sorry, an ICNIA, integrated communication navigation identification avionics package. So we have a half-quick, two JTIDS—I am sorry. The Air Force agreed that because of the change in the threat, we needed a couple more DB of antijam voice capability; therefore, they invented an enhanced JTIDS. That was TAC's No. 1 priority, so said General Creech.

We just got a letter yesterday that the Air Force has terminated the No. 1 priority, but five different radios to communicate with tactical airplanes.

Is there a general agreement at the table that we are just throwing money down the drain, doing everything for everybody, when, in fact, we could have greater commonality?

Mr. **Rosenbaum**. There is agreement by this person that you could have greater commonality.

Mr. **Sprey**. One word of caution, commonality can cause terrific disasters. In the absence of a competition—of actual hardware prototype competition—commonality almost every time will lead to disaster.

The F-111, and the main woes of the F-100 engine, were due to OSD forcing the Navy and Air Force to agree on common specifications which made it far worse for both of them.

In those noncompetitive programs, you certainly don't want commonality.

Mr. **Battista**. The F-15, earlier the point raised by Mr. McCurdy, isn't it true that some of the services, especially the Air Force, goes out of its way to kill anything that would threaten force structure, that, in fact, would greatly enhance our conventional fighting capability?

A few cases in point, medium-range, air-to-surface missile, standoff, PAVE Tiger, long endurance, cheap drum, and they love RPV's, and just as soon as they complete R&D, however, they kill them.

They use them as justification for saying this is how we will cope with a threat, but it comes time to produce them, they get killed.

Do you generally find that the real force multiplies, not the rhetorical ones, the real ones don't ever make it out of development?

Mr. **Braddock**. May I try to answer that?

Mr. **Battista**. Sure, I wish you would all take a crack at that.

Mr. **Braddock**. There certainly are circumstances you could point to, and not just in one service, where things like that have occurred. But if you take the bundle of things for deep attack, and you can keep that bundle together, you will buy some real capability.

You've got a fair chance of doing that, and make an example you could then hold up in the future to the services. You agreed you have a lot of capability to be bought here, we bought it, and we looked at your people in the field using it, it looks like it makes sense, because they are trying to develop procedures for it.

I think the test case is the deep attack basket of programs. Make that one work. It may require kicking it through. You may have a lever for the future.

Mr. **Battista**. Might require some micromanagement, then?

Mr. **Rosenbaum**. Nobody said micromanagement was all bad. There is some necessary balance.

Mr. **Battista**. When the General calls some guy on the staff or a Member of Congress and says, "Hey, the Army really needs this and OSD is thinking of killing it," that is not micromanagement, but when Congress kills it, that is micromanagement?

Mr. **Rosenbaum**. The problems you are laying out before, we all know to be severe. Whether some of the Packwood Commission reforms will solve them, I have no idea.

What Dr. Braddock is saying, and what I happen to agree with is in a much smaller area that we can grasp. A bundled package really does go against the grain that you are complaining about.

Here is an instance where at least once, I have heard somebody say, that in the interest of preserving a deep attack system that doesn't have a driver or a pilot in it he is cutting a main line program that has a driver or pilot in it.

That was the most significant thing I heard from a service agency in a long time. I think that some push, some management, micromanagement, or what ever you want to call it, from the Congress, should be put behind that umbrella concept or CDI initiative.

This approach says, we need this capability and to get this capability, we need a match of platforms, vehicles with drivers in it, and munitions. Unless we keep that match, we are not going to get what we want in terms of capability.

That is what is missing from the management approach we have taken. It is just beginning to bubble up from the levels of where the CDI offices are, and where certain people in the services are fighting a tough battle. It could use support from the Congress.

Mr. **Darden**. As someone who—the highest military rank I ever got was a slick sleeve in ROTC, and when a four-star general comes in followed by a three-star, and a colonel carrying the briefcases, and makes a request for you to support a particular program, you don't know whether to come to attention or salute or what.

It is a rather significant problem that we as Members of Congress tell us that—our acknowledged leaders tell us they have got to have that particular program.

Tony, anything additional?

Mr. **Battista**. My observation of the Defense research budget is we do too many things rather poorly instead of fewer things very well. The example I gave to the subcommittee, in 1976, we had 604, I believe, major program elements. Today we have about 810.

That is a 30-percent increase, and we have just got projects coming out of our ears right now, and when you get into full-scale development, another interesting observation, for every dollar you spend today in FSD, you generate a requirement for 10 or 15 or more in the 5- to 10-year period ensuing, and my observation is, we are just not getting there from here, because we are taking this shotgun approach.

Have you all made that same observation?

Second, with regard to testing, we are getting a terrible erosion of public confidence in weapons systems, and the Pentagon, because our tests are what I call bakey, for lack of a better term.

When you put a lunar lens on a helicopter, that doesn't exist in the real world, you are not showing anybody anything other than the fact that you are willing to cheat, or have contractor personnel in the control room telling the pilot when his imagery looks good enough to shoot, these are the things that cause the public to turn against defense, when in fact, we should be supporting it.

Can you comment on, one, are we doing too many things rather poorly; and, two, is the testing process over in the Pentagon really as screwed up as I suggested it is?

Mr. SPREY. Let me tackle that one.

First of all, we clearly are doing far too many things with far too many unpromising technologies. I think one of the fundamental problems, one that this committee could certainly deal with, is that we manage R&D as some kind of engineer's hobby shop. That is, every time somebody comes up with some goody, some advanced development that sounds sexy to a bunch of other technologists, that is what gets funded, and when you put a complicated enough group of such goodies together, then you get full-scale engineering development of a so-called system.

I would suggest that there is another way of going about defense, which is to start with war and the nature of combat rather than with engineering passions.

I think that can be done both at the procurement level and at the R&D level. It is not being done across the river, so it needs to be done here. This committee needs to sit down and consider testimony and evidence, not just on whether widget A costs this much, or it flies this far, or sends electrons with the following field strength, but whether in fact infantrymen need help first, or whether we need to do deep attack, or whether we need to fix up our submarine problem, or whatever.

Until you can come to grips with these combat essentials and use them to winnow that wonderful huge maze of technological goodies, there is no coming to grips with it.

I think my colleagues' fascination with deep attack is a classic case of that. Nothing could be more of a bottomless pit for money in pursuit of unachievable objectives—objectives which, if adopted by actual fighting men would grossly decrease their capabilities in the field, because deep attack is just long range artillery thinking amplified to the *n*th degree.

Mr. BATTISTA. I don't give a darn what strategy you are adhering to, deep attack or providing infantrymen. First of all, we can do both.

Let me just say that the mistake that is made over in the industry, by the way, and in the building, is the fact that there is a technology that is applicable only to deep attack, only to the infantry requirement, and that is nonsense, and I say the important thing is to develop the technology, not to push the technology, and how you apply it.

Well, let me say it gives you the flexibility to apply it in any way you like. I don't think it is really strategy-dependent, and you may disagree with me on that.

Mr. SPREY. I am not trying to say that unless you adhere to the maneuver strategy, all else will fail. I am saying if you do not pay attention, first, to the circumstances and nature of combat, then the large majority of your R&D line items will fail, no matter how seductive the technology. Just the fact that some weapon flies out 100 miles does not make it twice as effective as some that only fly out 50 miles. When neither or the two can distinguish a friendly from an enemy tank, then they are both useless—which you couldn't know unless you study and understand the nature of combat.

This idea that if you fly deep enough, you will find this promised target-rich environment, so full of all kinds of Russian forces so dormant that they will sit there and let you shoot them, that is a ridiculous idea.

In fact, the deeper you go, the less target-rich the environment and the more dangerous the defenses. People have not thought through the actual environment of those objects and forces you are trying to shoot, so this is a question of the realities of combat.

What do people do when you shoot things at them that kill them? If you don't take that into account, then you pursue these bottomless technological pits that lead nowhere.

Mr. ROSENBAUM. I am not going to argue strategy with you, but the one thing you said I have some strong feelings about. That is the perception that it is so easy for a group of dirty industry technologists to sell the Brooklyn Bridge to anybody, including the congressionally approved guardians of the national budget.

There seems to be a perception that, if you have a new widget, you can go find a place in the Department of Defense to get somebody to support that widget and take it ultimately to full-scale engineering development.

Mr. BATTISTA. We do have to close now.

In Washington, I have learned one thing: That not too many people really know how the Congress works; and secondly, perceptions are reality. It doesn't matter what the targets are, that is the perception, that is reality.

The third thing is that Washington, especially Capitol Hill, is non-utopian; for every action there is a corresponding reaction. Even Congress can't change that law.

When you have 600 toilet seats, and 700 ash trays, one, the perception that we are spending too much for defense becomes wasted, becomes true, and——

Mr. ROSENBAUM. I don't deny that, but I suggest somebody should take a look at the bigger picture. You take pride that your staffs are able to create a filter or a barrier that at least hopefully filters out the crazy ideas and accepts and promotes the good ones.

Why then does the perception exist, the reality, if you will, that the bureaucratic structure in the national defense establishment is not able to do the same thing?

That is a serious issue, and I think somebody ought to take a serious look at it. Why is there the perception that all the smart guys are outside the building?

Have we done anything in the selection process, in the name of conflict of interest that is not in our best interests?

Have we done something that has sort of guaranteed that that disparity remains and gets worse? Are we moving in the right direction? I don't have the answer. I am suggesting that somebody ought to take a hard look at it.

**Mr. Darden.** We will think about that one tonight. If nothing further to come before the committee, it would be an appropriate time to recess, and gentlemen, thank you, General, for your participation today.

We will stand adjourned until 10 o'clock in the morning.

[Whereupon, at 4:15 p.m., the subcommittee recessed, to reconvene at 10 a.m., Wednesday, March 12, 1986.]

# SCIENCE AND TECHNOLOGY AND UNIVERSITY INITIATIVES

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House of Representatives,
Committee on Armed Services,
Research and Development Subcommittee,
*Washington, DC, Wednesday, March 12, 1986.*

The subcommittee met, pursuant to call, at 10:20 a.m., in room 2212, Rayburn House Office Building, Hon. Melvin Price (chairman of the subcommittee) presiding.

Mr. Price. This morning the subcommittee will complete its review of the fiscal year 1987 RDT&E budget request.

The subject of today's hearing is the Department of Defense Science and Technology Program and our principal witness is Dr. Ronald L. Kerber, Deputy Under Secretary of Defense for Research and Advanced Technology. Following Dr. Kerber, we will hear from Dr. Robert M. Rosenzweig, president of the Association of American Universities.

Doctor, we are delighted to have you here.

Mr. Davis. OK. I would like to take this opportunity to welcome Dr. Kerber, a young, old friend. We have been friends for years, before he started this new position, and we understand you are doing a very fine job, and I just want to welcome you here. We are very pleased that you have this new position. We look forward to your testimony and all the good things you are going to have to say today.

Mr. Price. Thank you. You may proceed as you wish, and if you have a formal prepared statement, that will be printed at length in the record, and you can summarize if you care to.

## STATEMENT OF RONALD L. KERBER, DEPUTY UNDER SECRETARY OF DEFENSE FOR RESEARCH AND ADVANCED TECHNOLOGY, ACCOMPANIED BY DONALD I. CARTER, ASSISTANT TO THE DEPUTY UNDER SECRETARY FOR RESEARCH AND TECHNOLOGY

Dr. Kerber. Thank you, Mr. Price and Mr. Davis.

I am grateful for the opportunity to testify in support of the Department of Defense Science and Technology Program for fiscal year 1987.

I have with me Col. Donald I. Carter, Assistant to the Deputy Under Secretary for Research and Advanced Technology. Colonel Carter has a long and distinguished career in DOD Science and Technology and has appeared before this committee on many occassions.

As you indicated, I have a prepared statement for the record, and with your permission, I will summarize that statement at this time.

Today I will present to you an overview of the DOD Science and Technology Program and also address several topics of interest to the committee.

The U.S. interests are best pursued within a stable and peaceful international community. However, armed conflict, international terrorism, and regional instabilities adversely affect the Nation's ability to achieve what we perceive as national goals.

As you are well aware, the complexities of the world over the past decades have led to the development of sophisticated military forces to ensure the preservation of our lives and our freedom. The effectiveness of those forces depends to a great extent upon the quality and performance of the equipment provided them to accomplish their mission.

This administration has made substantial progress in modernizing and improving U.S. forces. The Peacekeeper, the Trident II, the B-1B and improved command, control and communications systems are among the many improvements that strengthen the Nation's security posture.

The weapons we are buying today must perform their functions into the 21st century. The technology used in their production has evolved over the past several decades. That technology is perishable.

There are new technologies that can be introduced into the forces almost immediately. However, for the longer term, it is paramount that this committee, the DOD and the Nation lay the foundation to meet future challenges by investing today in the technology needed for future forces.

Mr. **Dickinson**. Let me interrupt. Your statement right now is nonclassified, right?

Dr. **Kerber**. That is correct. It is my understanding the whole hearing is open.

Mr. **Dickinson**. Thank you.

Dr. **Kerber**. There have been significant technical improvements in materials, optics, lasers, integrated circuits, propulsion and other areas that are the foundation for future systems. I will highlight progress made in several technologies.

Integrated circuits have been a high leverage investment for DOD for many years. Great progress has been made since the vacuum tube days, and there is ample opportunity for continued progress.

The very high speed integrated circuit or VHSIC Program has received strong support from this committee, the DOD and industry. The VHSIC Program is at its midpoint in fiscal year 1986 with many milestones becoming realities.

Fully functional 1.25 micron VHSIC chips are available for system insertion; a number of brassboards have been demonstrated; and the ALQ-131 electronic countermeasures pod became the first operational system to have VHSIC technology inserted. VHSIC technology transition into weapon systems will continue to be the primary goal of the program.

The success of VHSIC has led us to consider a similar styled tri-service program to achieve progress in analog circuitry that VHSIC has accomplished in digital circuitry. A new start will be initiated in fiscal year 1987. It is known as the Microwave/Millimeter Wave Monolithic Integrated Circuit or MIMIC Program.

MIMIC's objective will be to make presently available laboratory gallium arsenide circuits affordable for missiles, radar, communications, SDI, and other applications. The need to have affordable and reliable analog integrated circuits at frequencies far above silicon frequency ranges is an important need for the future.

I consider MIMIC so important that it will be managed from OSD with full participation of the services in the planning and execution of the program. This management mode will also permit excellent coordination of complementary efforts by DARPA and SDIO.

Another area of great interest is aircraft technology. Aircraft play a key role in military forces, and it is important that the United States maintain a preeminent position in this technology. Programs are in progress that will permit us to maintain superiority of U.S. aircraft in a cost effective and timely manner.

Among programs underway are a smooth contour variable camber wing, an advanced digital-optical control, or fly-by-light, system, and the advanced maneuvering attack system on the F-16.

These examples plus others in the aeronautical propulsion area are important to maintain our national superiority in conventional type aircraft. In addition, now is the time to begin research on a new family of aerospace vehicles.

Conceptually, a future aerospace plane would operate at hypersonic velocities, that lie between mach 5 and mach 25, in the upper atmosphere or as a space launch vehicle accelerating directly into orbit.

DOD and NASA have carried out hypersonic research for a number of years. Advances in materials, structures, propulsion, and computational fluid dynamics have contributed to a consensus that an aerospace plane is possible.

The planned program will develop needed technologies including ramjet propulsion, advanced materials, and structures. The goal is to reach a point where we can prudently commit to an experimental X-type flight vehicle.

The participants in the program include the Air Force, Navy, DARPA, SDIO, and NASA. An overall management approach has been developed to ensure effective program planning and execution. Successful demonstration of the aerospace plane concept will open new horizons in long-range air defense, space transportation, and global transportation systems. I urge that you authorize the National Aerospace Plane funds.

Now I would like to discuss DOD-university relationships. As my predecessors have so ably stated, DOD has a keen interest in a healthy national technology infrastructure. At its center is a creative and productive university environment.

DOD has recognized the need for close university relationships. Universities are the source of much of our basic research; they are the source of our scientists and engineers; and, they are the source of expert advice.

Among the actions taken over recent years have been to increase DOD campus sponsored research, to sponsor a university research instrumentation program, and to establish the DOD university forum. These actions have served us well, and in fiscal year 1986, the university research initiative, or URI, was launched.

It is, indeed, heartening to note the support that this and other committees of Congress have given URI. The $100 million appropriated in December will be an excellent start for URI.

As it became evident during 1985 that URI funds would be appropriated, the DOD initiated action to define the program and plan for its management. Central to this process was to seek advice from the university community, and this was accomplished via the DOD-university forum.

A 75-page program overview has been prepared and distributed to over 1,500 universities. A management approach has been established to ensure a coordinated and balanced effort.

It is anticipated that contracts and grants will begin to be awarded by early summer and that both DOD and the universities will benefit from URI. By next year, I hope to be reporting on the success of this program.

I have only been able to touch upon a few of the programs making up the Science and Technology request of $5.4 billion. However, my statement contains substantially more detail, and I invite your attention to it.

The Science and Technology Program is the foundation for future systems and for a competitive edge relative to our adversaries. This program, which is performed by a combination of our industry, DOD in-house laboratories and universities, is vital to our Nation's future and the Department is committed to maintaining a viable level of fiscal and human resources to carry it out.

Gentlemen, my closing thought for you is this. I have been in this job for only 2 months. Even though I have been a part of defense R&D since 1966, I have yet to become comfortable with the mirage of convoluted acronyms from initial briefings I have received. However, I accepted this job knowing it has an awesome responsibility to keep our technology base ready for all possible scenarios and to avoid technological surprise. I have yet to put my total input into the program, but I can tell you that I am dedicated to improving technology transition, system survivability and technology to improve manufacturing efficiency and logistics. I will work diligently to improve the management of our Science and Technology resources. But without your help and full support, I am deeply concerned that short-term budget issues will erode the S&T program and imperil our country's future.

This concludes my opening remarks, and I will be pleased to answer questions you may have.

## PREPARED STATEMENT OF HON. RONALD L. KERBER

Mr. Chairman and Members of the Committee:

### I. INTRODUCTION

I am grateful for the opportunity to testify in support of the Department of Defense (DoD) Science and Technology (S&T) program for FY 1987.

Today I will outline to you the need for a DoD S&T program, the role that it plays in the overall defense program and its relationship to the threat from our adversaries. Also, I plan to describe progress on several of our management initiatives and discuss some major programs that make up the DoD S&T program.

The United States' interests are best pursued within a stable and peaceful international community. Armed conflict, international terrorism and regional instability adversely affect the U.S. and its allies in their efforts to achieve self determination, democratic institutions, economic development and respect for human rights. The complexities of the world over the past decades have led to development of sophisticated military forces to ensure the preservation of our lives and our freedoms. National survival depends upon the success with which we prevent attack upon the U.S.'s vital interests.

The Soviets have long since realized that communist ideology will not be the force of change for the future. They are now using military power as their primary tool to influence international events. The Soviets are willing and have invested a significant amount of their gross national product into increasingly modern and sophisticated weapons for the projection of Soviet influence into various regions of the world. Countering this force is a national challenge.

This Administration has made significant progress toward improving U.S. military forces. Certainly the strategic posture will be strengthened by the PEACEKEEPER, the B-1B and the TRIDENT II; strategic connectivity will be strengthened by improved $C^3I$; and the ability to respond over a range of combat situations is increased by modernization of conventional forces. However, the weapons we are buying today will have to perform their function into the 21st century and the technology used in their production was evolved over the past several decades. There are some new technologies that can be introduced almost immediately. However, in order to prepare for the longer term future, the DoD and the nation must lay the technology foundation for the future, in the face of great uncertainty, by investing today in the technologies needed to meet future challenges. This is a strategy that can work to the US's advantage.

Technological progress increases the deterrent value of U.S. forces and provides a hedge against hostile technological breakthroughs by potential adversaries. Advanced technology also imposes strategic costs on the Soviets by causing them to divert resources from more easily produced systems to counter more capable U.S. equipment. The importance of technology has never been more crucial than it is today.

The technological superiority that we enjoy over potential adversaries is a direct result of the investments in research and development and the continued search for advanced technologies by industry, universities, and DoD in-house laboratories. There have been significant improvements in materials, optics, lasers, integrated circuits, software, computers, aeronautical propulsion, sensors, and other technologies that are the foundation for future defense systems. The President's Strategic Defense Initiative (SDI) is an important example where new technologies are examined to determine the feasibility of a concept that would enable us to move from a deterrence strategy based on nuclear retaliation to one based on defense against ballistic missiles.

As you will see from the S&T projects discussed later, emphasis is being given to technologies that provide the greatest increase in nearer term capabilities and advantages while ensuring that long range investigations are not overlooked. Also, assessments are made of emerging technologies to ensure not only that high payoff opportunities are pursued but also that adverse technological suprises are avoided.

Projects are being undertaken that cover a broad spectrum of military applications. The uncertainty of the international climate and the range of combat situations and environments that could be encountered necessitate this approach. This need is also emphasized because of the traditional changes in strategy and tactics resulting from shifting balances between offensive and defensive capabilities. The tools for commanders of tomorrow are cast in the technologies the country is exploring today.

The S&T program request for FY 1987 is $5,375 million which includes the Army, Navy, Air Force and Defense Agencies programs less the Strategic Defense Initiative (SDI). Table I is a summary of FY 1986 amounts and our FY 1987 request. The S&T program encompasses the SDI in the Advanced Technology Development category; however, this will be covered by separate testimony. The SDI amounts in Table I are for informational purposes. The S&T funding history is detailed in Appendix I.

The S&T program is the means by which a technical foundation is prepared to meet the uncertainties of the future. The nature of future international situations cannot be precisely defined but we can be certain that, in the terms of world technological competition, advanced technology will be an essential element of national survival. The DoD S&T program, along with the technology explorations of industry and universities, is the means by which we can make significant steps toward developing and maintaining a technological posture second to none.

TABLE I
SCIENCE AND TECHNOLOGY PROGRAM
(Dollars in Millions)

| | FY 1986 | FY 1987 |
|---|---|---|
| Research | | |
| Military Departments | 858 | 876 |
| Defense Agencies | 166 | 110 |
| Total Research | 1,024 | 986 |
| Exploratory Development | | |
| Military Departments | 1,620 | 1,769 |
| Defense Agencies | 805 | 830 |
| Total Exploratory Development | 2,425 | 2,599 |
| Advance Technology Development | | |
| Military Departments | 1,287 | 1,463 |
| Defense Agencies | 201 | 321 |
| Total Advanced Technology Development | 1,488 | 1,790 |
| TOTAL SCIENCE AND TECHNOLOGY | 4,937 | 5,375 |
| Strategic Defense Initiative | 2,746 | 4,785 |

Notes: Numbers may not add due to rounding
Does not include Gramm-Rudman amounts.

## II. MANAGEMENT ACTIONS

Within the context of S&T program management are activities that are not technical programs in themselves but rather are vehicles by which more effective technological products and progress are produced. The origins of these activities stem from both Congress and the Administration and they play a significant role in technology management. This chapter describes and provides status on some of these activities.

A. Small Business Innovation Research Program

The Small Business Innovation Act of 1982 was designed to strengthen the small business role in federal research and development and to stimulate technological innovation in the private sector. DoD is an active participant in the Small Business Innovative Research (SBIR) program and in FY 1985 received over 3,500 proposals and made 525 awards. FY 1986 funding for SBIR will approximately double and the number of contracts awarded under this Act will increase substantially. The FY 1987 program should see even higher levels of support.

The SBIR program is beginning to show results. A small business in New England developed a low-cost 2-frequency laser for performing linear metrology and other precision measuring techniques for defense and is now marketing it in the private sector. While doing work on oxidation resistant coatings another small business has developed a process that permits aircraft engines to operate at higher temperatures for longer periods of time and at lower cost. The firm has been awarded a contract with the Air Force and has teamed with a major aerospace company. Because of these and other examples of innovation by participants, it is our view that the SBIR program is working as envisioned by the Act.

B. Role of Universities in DoD RDT&E.

Universities play a major role toward ensuring the strength of DoD science and technology. They are the principal performers of the basic research which underpins technological advances. Hence, they are vital in maintaining the country's military and economic strength. They also represent a vast resource of trained researchers which makes possible university contributions to the DoD's science and technology program. In addition to generating scientific and technical insight essential for future innovation, university research provides the stimulating environment for developing future scientists and engineers needed by DoD, defense industries, and the nation.

The dialogue continues between the Department and academia to strengthen research capabilities of the nation's universities. In its third year of operation, the DoD-University Forum is currently addressing issues in science and engineering education, foreign language and area studies, and the impact of export controls on university research. Also, the Forum is a place for valuable, candid and constructive discussion on complex matters such as the university role in the Strategic Defense Initiative. The Forum has provided useful feedback on the University Research Initiative by introducing the university perspective during the planning stage. This has enabled the development of a strategy which satisfies DoD objectives and provides a clear focus for the university community.

### C. University Research Initiative

The University Research Initiative (URI) emphasizes selected emerging technologies that have a high payoff potential for national defense and at the same time will strengthen the universities' abilities to conduct research and educate scientific and technical personnel in defense-critical disciplines.

DoD has an important stake in both the research produced by universities and the quality of the scientific and engineering personnel being educated in defense-related disciplines because one in six American scientists and engineers are engaged in defense-related areas. The majority of these scientists and engineers, almost one-half million in all, are involved in state-of-the-art technologies that are not only crucial to the defense mission, but also are at the cutting edge of technologies essential to modern society.

Technologies that will be supported under URI include artificial intelligence, robotics, ultrasmall structures, high performance materials, structural and electronic polymers, fluid dynamics, and biotechnology. For each technology selected, a balanced program will be devised to include some or all of the following components: multidisciplinary research centers and/or programs of interest to national security; exchange scientists and engineers to facilitate the flow of ideas between university and DoD laboratories; instrumentation grants to increase the productivity of university research; and, fellowships to train the most qualified people to sustain the momentum generated by URI.

URI is a coordinated tri-Service/DARPA effort, integrated by OSD for maximum effectiveness. It accelerates the advance of emerging technologies and simultaneously improves the quality and challenge of university research.

### D. Independent Research and Development (IR&D)

Industry's independent R&D serves a critical function in high-technology industries. A portion of this type R&D is allowed as an indirect cost in DoD contracts, and managed through DoD's IR&D program. The IR&D effort enables industry to exploit scientific discoveries rapidly, improve current products, and develop new system capabilities in a cost effective manner. This is important to the overall defense R&D effort because it encourages innovative concepts and fosters competition between viable alternatives.

IR&D has led to many significant gains in defense capabilities. Improvements on the B-1B bomber, PEACEKEEPER and Rolling Airframe Missile, E-2C and C-17 aircraft, Mark 48 Advanced Capability Torpedo, the SQS-56 Radar and the TARTAR Fire Control are typical examples. The latest version of the F-15's high performance air-to-ground radar incorporates the result of past IR&D by providing a synthetic aperture radar operating mode in conjunction with a highly capable programmable signal processor that is common to the F-18, F-14, and other F-15 applications.

DoD has emphasized to its contractors the need to expand their interactions with universities and to pay special attention to weapons systems supportability and maintainability. Positive results are emerging in both areas. Industry is encouraged to create joint research programs, consulting agreements, faculty and student employment and scholarships. The goal is to speed the transition of research discoveries from academic to DoD and industrial applications. As for weapons system supportability and maintainability, data compiled by the Naval Supply System Command shows that logistics-related IR&D efforts increased between 10% and 20% after weapons system support was identified as an IR&D special interest item. Corporate IR&D efforts are a valuable adjunct to the DoD S&T program and we are leveraging the resources being devoted to IR&D by emphasizing areas of particular importance to future defense systems.

### E. Exchange of Technical Information with the Scientific Community

A recent national policy on the transfer of scientific, technical, and engineering information enhances DoD relations with universities and industry. The policy establishes that, to the extent possible, the dissemination of results from Federally funded fundamental research will be unrestricted. While this broad policy incorporates DoD's past practice, the DoD is pleased to re-emphasize it within the Services and Defense Agencies.

The 98th Congress granted DoD the authority to withhold certain export controlled technical data. Implementating directives have established procedures by which technical data can be shared within the U.S. with a minimum of administration and without losing the protection of export laws. Under these procedures, the Services have reported no changes in the total number of presentations and reports reviewed and the number of denials has remained constant. It is our view that a good balance has been achieved between the information needs of the U.S. technical community and the requirement to restrict the flow of valuable information to our adversaries.

## F. Management of Mission-Critical Computer Resources (MCCR)

The Deputy Under Secretary of Defense for Research and Advanced Technology serves as the Senior Official for Mission-Critical Computer Resources. In this role, the Deputy is responsible for policy, review, and oversight with respect to systems that fall under Section 2315 of Title 10, United States Code (the Warner Amendment). The Senior Official chairs the Computer Resources Council and is supported in all areas, including technology, by the Defense Computer Resources Board (DCRB). Criteria and procedures have been established for granting exemptions under Section 2315 and for conducting Computer Resources Council (CRC) reviews. Reviews may be called of any MCCR system whose life cycle costs exceed $100 million. The system is working well and significantly improves the procedures by which MCCR resources are acquired.

Consistent with the January 1984 report to Congress on Computer Technology, a Computer Systems Interface Working Group has been established under the DCRB and is developing a coordinated approach to the next generation of military computers. Also established under the DCRB is a Software Reliability Panel that is developing a set of criteria for measurement of software reliability in weapons systems. In addition, the directive on the Management of Computer Resources in Major Defense Systems is being revised to include policies on the use of Ada (the new DoD high order language for MCCR software), the use of commercially-available microcomputers, and improved approaches to software development and maintenance.

## G. Program Coordination

Coordination of technology programs within DoD, between government agencies and among allies is a major function of this office. In addition to normal S&T information processes, discussed later in this statement, special procedures are established for cross-Service areas. For example, a technical review group has been established to insure coordination and integration of SDI sponsored activity with other programs. The Department has representation on interagency committees in areas where common interest exists. The Aeronautics and Astronautics Coordinating Board is the mechanism for formal coordination of NASA and DoD activities. International S&T coordination exists primarily through the NATO Defense Research Group and The Technical Cooperation Program. This is supplemented with memoranda of agreements, information exchange programs and other agreements when more specialized arrangements are required. Overall, both formal and informal procedures exist to coordinate DoD S&T activity with appropriate organizations.

## H. Program Management and Administration

A number of actions have been taken to improve the management of the S&T program and the pace at which new capabilities are transitioned to forces in the field. For example, the Navy's exploratory development program has been reorganized to reduce the number of program elements to correspond with Navy mission areas and the warfighting objectives of the maritime strategy. This action has significantly reduced administration tasks and paperwork required to define and review the program.

## III. SELECTED FY 1986 TECHNICAL PROGRAMS

The S&T program supports many missions and many military applications. Projects range from basic research to large scale demonstrations of potential systems. Much of the work is generic and has many uses. Examples are semiconductor, software, materials, sensor and laser technologies. Other projects such as chemical defense, ballistics, medical and armor technologies are more specific in their military application. It is not practical to discuss all S&T endeavors; however, a number of the projects will be highlighted.

### A. Very High Speed Integrated Circuits

We are now at the mid-point in the highly successful Very High Speed Integrated Circuits (VHSIC) program. The goal of the VHSIC program is to increase the U.S. technology lead in integrated circuits (ICs). ICs are becoming the cornerstone for improved electronics in future weapon systems. The result will be systems that are more reliable and because of their self-test ability, easier to maintain. Also, in addition to the enhanced processing speed afforded by VHSIC, there will be reduced size and weight improvements for many military applications.

Most VHSIC 1.25 micrometer integrated circuits are fully functional with thousands of sample chips available for weapon system insertion. In addition, a number of brassboards are operational that can provide signal processing capabilities at the leading edge of technology. The first insertion of VHSIC technology in an operational system has been accomplished in an AN/ALQ-131 electronic countermeasures (ECM) pod used with several U.S. fighter aircraft to counter hostile electronic systems. This insertion demonstrates that VHSIC technology can be applied to systems at an early date to enhance reliability and maintainability. The reliability of the AN/ALQ-131 Techniques Control Assembly (TCA) will be increased 50-60 times using VHSIC technology. The TCA also exploits built-in-test features of VHSIC and significantly reduces mean-time-to-repair of this equipment.

### B. Microwave/Millimeter Wave Monolithic Integrated Circuits (MIMIC)

The Microwave/Millimeter Wave Monolithic Integrated Circuits (MIMIC) program is a new start in the DoD S&T program. It involves development of state-of-the-art monolithic gallium arsenide (GaAs) integrated circuit technology for microwave and millimeter wave military applications. The development, manufacture and application of analog monolithic integrated circuits, based on GaAs technology and operating at microwave and millimeter wave frequencies, will be demonstrated to accelerate their use in weapons and equipment.

The MIMIC program is oriented toward major improvements in analog sensor electronics, the "eyes and ears" of electronic systems. It is similar to the benefits that VHSIC will provide for the processor or "brains" of electronic systems. MIMIC's objective is to demonstrate affordable applications in aircraft, missiles, surveillance and other electronic systems. Potential uses include phased array antennas, radar, ECM and communications equipment in addition to millimeter wave seekers for smart missiles.

The MIMIC program will identify major barrier problems that must be solved, permitting industry to concentrate its efforts upon the most critical issues, particularly those affecting affordability. Also, MIMIC will address individual Services' needs and will encourage multi-Service cooperation in later system developments. The program will be managed from the Office of the Secretary of Defense (OSD) with Service participation in both management decisions and program execution. The MIMIC effort compliments Defense Advanced Research Projects Agency (DARPA) and Strategic Defense Initiative Organization (SDIO) low power, radiation hard digital GaAs integrated circuit programs. The payoff from a successful MIMIC program will be both increased performance and affordability for a wide range of equipment at frequencies of great interest to military applications.

C. Software Technology

Computer software, the intelligence programmed into mission-critical computer systems, is a key element in the ability to make significant technology improvements in most modern weapons. A three-pronged initiative to provide more reliable and cost effective software for Defense systems is being pursued.

The Ada common computer programming language has been designated for use in DoD mission critical systems. Over 100 Defense programs, including the Advanced Tactical Fighter, the WWMCCS Information System, and the Advanced Field Artillery Tactical Data System are programmed to use Ada. It is also being used outside DoD. Ada is a military standard, an American National Standards Institute standard, a Federal Information Processing standard and is expected to be accepted by the International Standards Organization in 1986. There is a growing private sector base for widening the use of Ada. Approximately 40 companies are developing Ada compilers and most major contracting firms have a nucleus of Ada expertise. The use of Ada as a standard language in mission critical computers promises to be a very significant step toward improving productivity and performance in the software development and maintenance process.

The Software Engineering Institute (SEI), intended to accelerate the use of new software technology in Defense systems, is operational at Carnegie Mellon University. Key projects include: (1) approaches to using commercially-available software, (2) the evaluation of Ada compilers and software tools, (3) the development of a showcase "software factory", and (4) the improvement of graduate level curricula in software engineering. The SEI has established both industry and university affiliate programs and is providing assistance in software engineering for Defense systems.

The Software Technology for Adaptable, Reliable Systems (STARS) program will improve DoD's software capability by bringing a high degree of discipline, technology, and automation to software development, evolution, and management processes. The goal is to meet defense software requirements of the 1990s by achieving a tenfold increase in today's productivity and comparable improvements in quality and reliability. STARS has already demonstrated reusable software capabilities for missile guidance and control and signal processing. The program is now focusing on exploitation of tools and other products already emerging from the private sector. In addition, STARS is being oriented to better support on-going major efforts such as the World Wide Military Command and Control System, SDI and the strategic computing program. The plan includes development and prototyping of common interface concepts to achieve compatibility among software engineering environments across industry and DoD and to provide incentives to create a robust software tools marketplace. The improvement of software development, productivity and reliability is a major S&T objective and the STARS program is a key step toward achieving that goal.

### D. Aircraft Technology

Airpower continues to be a key factor for a credible national defense posture. This factor is well recognized by potential adversaries, as evidenced by their deployment of capable and technologically advanced aircraft. The DoD aircraft technology program is directed toward maintaining superiority of

U.S. aircraft in a cost effective and timely manner. A key aspect of the S&T program is the transitioning of technology from laboratory devices to application via large scale demonstrations. Several "firsts" have been achieved this past year.

In cooperation with NASA, flight testing of a modified F-111 aircraft with a smooth contour variable camber wing has been initiated. This Mission Adaptive Wing can automatically change shape in flight to optimize aerodynamic performance for the mission segment being flown. That is, the wing can be shaped for maximum maneuverability, for maximum cruise range, or for reduced supersonic trim drag. The technology is potentially applicable to a wide range of military aircraft from fighters to strategic bombers.

Also, flight tests of the Advanced Digital-Optical Control System (ADOCS) in a modified UH-60 Blackhawk helicopter have been initiated. This fly-by-light system features data transmission through optical fibers rather than wire, as in the conventional fly-by-wire systems. The ADOCS offers increased battlefield survivability and improved reliability. In addition, it will permit development of task-tailored handling qualities for improved mission effectiveness and reduced crew fatigue.

The Air Force is continuing to investigate the feasibility of an Advanced Maneuvering Attack System (AMAS) on the F-16 Advanced Fighter Technology Integration aircraft. The AMAS provides highly accurate and survivable maneuvering attack profiles against ground targets at very low altitude, as well as improved capabilities in air-to-air combat. This investigation will yield a better understanding of the concept of advanced tactical flight management for application to the Air Force Advanced Tactical Fighter (ATF).

Modification of an Air Force F-15 aircraft to demonstrate enhanced maneuvering capabilities and short takeoff and landing technologies is continuing. The technologies involved include two-dimensional thrust vectoring and reversing exhaust nozzles, an integrated flight and propulsion control system, advanced cockpit displays, three lifting surfaces (wing, tail and canard), and rough/soft field landing gears. The program will demonstrate improved combat maneuverability and effectiveness and the capability for operations from bomb-damaged or unprepared runways. The first flight is planned for early 1988.

E. National Aerospace Plane

Joint planning is underway with NASA for a National Aerospace Plane research program that could, if successful, lead to a new family of aerospace vehicles. Conceptually, a future aerospace plane would operate as an airplane at hypersonic velocities in the upper atmosphere, or as a space launch vehicle capable of accelerating directly into orbit. The impact on both aeronautical and space operations would be significant.

DoD and NASA have carried out hypersonic research for a number of years and recent advances in hypersonic propulsion, advanced materials, structures and computational fluid dynamics have contributed to a consensus that an aerospace plane is possible. The concept, developed by DARPA and NASA, centers on a hydrogen-fueled aircraft capable of horizontal takeoff and landing and operating at speeds between Mach 5 and Mach 25 and at altitudes between 100,000 and 350,000 feet. Present plans involve the maturation of key technologies, propulsion module development, and airframe design of a flight research vehicle.

Participants in the proposed program include the Air Force, Navy, DARPA, SDIO and NASA and a program management structure is in place. The FY 1987 request includes specific program elements to fund the DARPA, Navy and Air Force portions of the program. Successful demonstration of the aerospace plane concept will open new horizons for applications such as a long range air defense interceptor, space transportation and global transportation systems.

## F. Materials and Structures

The S&T program continues to emphasize materials development with most of the effort being in metal-matrix, carbon-carbon and ceramic matrix composites. The metal-matrix composite program has moved into the demonstration phase with each of the Services engaged in important development and test programs. The Army is developing lightweight metal-matrix and organic matrix composites for howitzer and bridge building components. The Navy is fabricating missile fins which will be flight tested during the coming year and the Air Force has successfully ground tested a full scale tactical missile motor case built almost entirely of metal-matrix composites. In addition, the design, fabrication and testing of full scale ventral tail fins for a fighter aircraft is underway.

In the spacecraft area, development of a small metal-matrix antenna that will meet survivability requirements for space components is underway. An identical antenna is being made from carbon-carbon composites so that direct comparisons of electrical and survivability characteristics of both materials can be obtained. While most of the composite materials work in the S&T program is supporting traditional terrestial use and spacecraft requirements, the Strategic Defense Initiative program also draws on the existing technology base for its needs and in some cases has jointly supported new programs. In a similar fashion, the National Aerospace Plane program will draw heavily on material technologies that have emerged over the past few years.

Tactical, strategic, and space missions continue to dictate the need for greater survivability in hostile environments. Most material and structures projects include testing for susceptibility and vulnerability to directed energy weapons in addition to traditional performance and environmental tests. This is considered an essential element of future programs because of the ever increasing ability of the Soviets to field advanced laser systems. The materials and structures program meets this challenge.

### G. Aircraft Propulsion Technology

Aircraft propulsion technology continues to be a high-payoff area for DoD. During the past year, we demonstrated most of the engine technology required to permit the development of a Joint Advanced Fighter Engine without incurring performance compromises that have plagued some past fighter engine developments. Also, significant performance improvements were demonstrated in the 6000-hp class Modern Technology Demonstrator Engine programs in a technical effort that will be completed in 1986.

Because propulsion system performance gains are the source of high military payoffs, we are defining an innovative integrated exploratory and advanced technology development program aimed at increasing the capability of aircraft turbine engines by 100% by the turn of the century. The major features of this program are integrated materials/propulsion technology efforts and DoD/contractor efforts to permit higher payoff/higher risk approaches in exploratory development. Six major aircraft engine manufacturers have formulated and presented their individual plans for achieving this goal, which include significant complementary Independent Research and Development efforts. The program will be fully defined this year, and will lead to large increases in aircraft capability (for example, a sustained Mach 3+ capability in an F-15 size aircraft and a cruise missile of intercontinental range in an air launched cruise missile size vehicle) by the turn of the century as well as continued U.S. preeminence in this vital area.

### H. Medical Research and Development

The objective of the Medical and Life Sciences program is to improve combat casualty care, to prevent militarily important diseases and injuries, to maintain and enhance combat effectiveness, and to increase human safety in military systems. The Armed Services Biomedical Research Evaluation and Management Committee (ASBREM) continues to ably plan and coordinate tri-Service aspects of the medical R&D program. In addition to conducting FY 1986 S&T reviews, ASBREM assisted OSD in topical reviews of the medical materiel as well as impact and acceleration research programs. ASBREM has become an essential tool in the management of medical research and development.

The Medical and Life Sciences program continues to address both basic and applied research unique to military operations. During the past year, the program has conducted a field study on the use and nutritional value of new rations and the suitability of a new combat field feeding system. Also, human testing on an anti-malarial vaccine was initiated and a much improved system for the care of Air Force casualties contaminated with chemical agents was developed. Cold weather uniforms for helicopter pilots, better boots and gloves for the soldier and new anti-G devices for pilots are typical examples of essential personnel support items required to better accomplish the combat mission.

### I. Chemical Defense Technology

The continuing chemical threat to U.S. forces drives an expanding chemical defense program in both defensive and retaliatory areas. The development, testing, and procurement of products resulting from technology advances are being undertaken to overcome major deficiencies. In addition to development of protective and retaliatory systems, programs for safe and effective disposal of obsolete, unusable, or leaking chemical munitions are underway. This is important because in the event that a chemical warfare treaty is achieved, stockpiles must be destroyed by a predetermined date, a difficult task with present technologies.

The chemical defense S&T program is performed by the Military Departments with the U.S. Army serving as the executive agent under a joint-Service agreement that coordinates requirements and programs. In order to broaden the innovative base, the program has been expanded into university and industrial organizations as well as DoD in-house laboratories. Progress is being made in many areas.

A mobile nuclear, biological and chemical (NBC) reconnaissance system, easily operated by untrained troops, is being tested. A mobile remote detector based on the principle of differential absorption/differential scattering LIDAR was constructed and successfully tested against simulants in open air ranges out to eight kilometers. Also, several items of equipment to assist in the care of battlefield casualties have been developed and promising leads exist to improve pretreatment of nerve agent poisoning. These and other projects improve our chemical defensive posture.

In addition to the defensive programs, the Department is undertaking relatively modest retaliatory improvements. Exploratory work is in progress to develop new, more efficient and cost effective air delivered systems. Also, we are continuing advanced development of the Multiple Launch Rocket

System chemical warhead to provide our forces with a mid-range ground launched delivery system, a capability we do not now have. These new capabilities will improve the nation's overall deterrent posture in this critical area.

In the management area, an NBC survivability office has been established to facilitate incorporating NBC protection into military equipment and, to better handle chemical data, a chemical/biological defense Information Analysis Center is being established. A total of seven development items were type classified and four new items achieved materiel release/first unit equipment status this year. The Foreign Weapon Evaluation program has been an excellent means of acquiring allied equipment and several items are currently being tested. The DoD will continue to emphasize chemical defense developments in order to ensure a credible U.S. chemical deterrent and if deterrence fails that U.S. forces will be able to survive and operate on the chemical battlefield.

## J. Research

The DoD Research (6.1) program provides a long range outlook for the Department. This work is accomplished by the universities, industry and the in-house laboratories. However, the universities are the dominant performer with about 50 percent of the research funds allocated for their explorations. The goal is to improve the U.S. technology posture and help guard against adverse technological surprise. Typical examples of areas to be emphasized this year include:

o Nonmetallic Structural Materials: A credible nonmetal structural material must possess an appropriate combination of strength, stiffness, toughness, durability, and damage tolerance. This program is directed toward the understanding and control of two classes of nonmetallic materials that depend predominantly on covalent or ionic bonding: ceramics for high temperature applications and hydrated cements for construction uses. An understanding of fundamental principles in these areas will obviate or diminish the need of trial-and-error testing common in materials development. Also, it will enable future developers to model the performance of these materials for future applications.

o Hot Atom Surface Chemistry: Difficulties are created when spacecraft traveling in low-earth orbits (200-600 km) collide with ambient atmospheric particles at velocities on the order of 8 km/sec, corresponding to energies near 5 eV for oxygen atoms, the predominant species present at these altitudes. Materials in space react with oxygen, degrading performance or causing catastrophic failure of optical, electronic, or structural components. The diffuse region of light (the "Shuttle Glow") observed surrounding the surfaces of spacecraft and satellites has not been fully explained but reactions at or near vehicles surfaces are implicated. These and other hypotheses need to be tested by laboratory experiments on the reaction of thermally fast atomic and molecular species with surfaces and with each other to minimize adverse effects of these high speed collisions.

o Millimeter Waves and Target Acquisition: Imaging sensors are required for advanced target acquisition systems. Millimeter waves can operate through aerosols but techniques for better control and processing of this type radiation is needed. Research programs will study surface electromagnetic wave phenomena in the millimeter wave length regime and explore the applicability of multi-aperture systems for imaging in cluttered environments. In the next two years experiments on the effects of adverse weather upon the propagation and imaging ability of near millimeter waves should be completed and the applicability of computer models to simulate the performance of near millimeter wave returns from snow and vegetation will have been assessed. This will form the basis for first-principles modeling efforts of near millimeter wave "clutter" and provide a stronger base for the design and use of systems employing millimeter wave techniques.

o Plasma Based Propulsion: The increasing emphasis on an improved propulsion capability in earth orbit presents unprecedented challenges for the advanced space propulsion community. A major portion of the research under this initiative will be the improvement of magnetoplasmadynamic thrusters so that they become capable of sustained operation at megawatt power levels. Electrode and insulator lifetimes have been identified as primary barriers to sustained operation. The research will be directed to electrode mass loss mechanisms and other conditions that cause inefficient operations.

The above examples are but a few of the investigations underway in the basic research program. Research is being conducted in submicrometer electronics, biotechnology, artificial intelligence, free electron lasers and other projects of military interest. It is from this broad range of basic research projects that technical options of the future will be shaped.

### K. Search and Surveillance

The undersea, battlefield, and aerospace search and surveillance missions continue to generate requirements for electronic systems development. These systems are normally based on some form of acoustic, radio frequency, microwave, millimeter wave and/or electro-optics sensor technology. They are used to achieve increased capabilities in target detection, target location and target identification by increasing sensor resolution and sensitivity and by decreasing the false alarm rate. At the same time it is necessary to achieve savings in cost, weight and volume, along with improved survivability, reliability and maintainability. Examples of S&T programs in search and surveillance are discussed below:

o Night Operations: Night and inclement weather sensor systems for land combat vehicles, aircraft, ships, missile systems, and fire control continue to be improved. Active sensor developments include coherent laser radar and millimeter wave radar devices. Passive sensor devices include infrared search and track systems and focal plane thermal imaging arrays with thousands of detectors, as well as battlefield acoustic sensors. Advances in uncooled detectors for thermal imagers have led to a new thermal sight for the M16A2 rifle that will be demonstrated in 1986. This sight will be effective at combat ranges and will weigh less than four pounds. In addition, common module, low cost carbon dioxide laser rangefinders and target designators are being developed to complement night vision systems. These technology advances provide U.S. forces with an excellent night and near all weather operational capability.

o Aerospace and Surface Surveillance: Long range, high resolution airborne and spaceborne radar and infrared sensor systems needed to locate and identify targets in the air and on the surface are being developed. The Air Force Avionics Laboratory and NASA are jointly conducting experiments using shuttle and airborne radar components along with advanced signal processing techniques to demonstrate the potential for spaceborne radar as a stand-off illuminator in a bi-static mode for passive all-weather surveillance. Bi-static radars, with the transmitter and receiver on different platforms, permit passive operation with respect to hostile radar warning systems. Another important thrust is the development of flush mounted solid state phased array transmit/receive modules on military platforms to eliminate cumbersome rotating search and surveillance radar antennas. Also, a major effort is underway to harden sensors against electronic jamming and laser countermeasures.

o Undersea Surveillance: The trend toward less noisy hostile submarines necessitates emphasis on the development of better sensors and techniques to locate quiet targets. Among the developments are non-acoustic techniques, such as magnetic and optical sensors with advanced signal processing, that are proving to be effective in the detection, localization and classification of undersea targets. It is extremely important that the U.S. maintain a technology lead in this area so that commanders engaged in combat will have the best equipment in the world for developing strategy and tactics that will ensure success in an important military mission--undersea warfare.

### L. Avionics/Navigation

The development of a single integrated system to replace numerous electronic "black boxes" that perform essential functions on aircraft platforms has been a design goal for several decades. The emergence of VHSIC devices, computer software improvements and the digital revolution make this objective a reality. Also, progress has been made in low cost laser and fiber optic sensors, 3-D panoramic high brightness cockpit displays and voice interactive systems. In addition major advances are underway in cockpit automation, pilot decision aids and artificial intelligence to optimize use of radar, electronic warfare, electro-optics sensors and weaponry equipment. Avionics and its uses continue to be a fruitful S&T work area because of rapid technological changes in this area and the major impact it has on mission effectiveness.

### M. Directed Energy Technology

The focus of directed energy technologies is transitioning from higher power lasers to lower power devices with a potential for near term conventional weapon applications. High power laser devices are now in the Strategic Defense Initiative research program.

Candidate devices are being developed to establish two parameters (capabilities and limitations) that will form the basis for making future weapon decisions. Current efforts will result in rugged, small, low cost devices suitable for military applications. Laser developments include devices that are capable of operating at wavelengths that result in higher quality atmospheric transmission and at frequencies that can be shifted rapidly to optimize their effectiveness. Other efforts are focused on technologies to improve the optical quality of laser beams, to reduce dependence on complex, high cost optics and to improve the delivery of laser energy at significant ranges.

## N. Conventional Weapons Technology

The conventional weapons program provides technology for advanced weapons required in non-nuclear armed conflict. This includes weapons ranging from small arms, tanks, artillery and aircraft guns, land and sea mines to guided missiles, projectiles and torpedoes. The program continues to make significant progress.

Among programs underway is the Army's Fiber Optics Guided Missile (FOG-M) that has demonstrated the use of a commercial optical fiber as a data link between a missile and a ground based command station. Target images from the seeker are transmitted via a trailing fiber to a ground station and guidance signals are then sent back to the missile via the same fiber. The original application was for an antiarmor weapon. However, recent experiments have shown that the FOG-M has potential use in an air defense role. Indeed, the tenth firing of the FOG-M demonstrated this capability against target helicopters.

There is an urgent need to increase the safety of munitions without compromising their performance. The Navy is concerned about the survivability of ships that contain large stores of high explosives. Munitions that could survive exposure to fires, impacts from bullets and adverse electromagnetic environments would have attractive advantages. Technology programs have produced some explosive and propellant chemicals that reduce sensitivity without reductions in energy output. These are being scaled to full sized warheads and rocket motors for testing.

The Services are jointly demonstrating a Hyper Velocity Missile (HVM) that has potential for defeating advanced armored vehicles. The HVM is an alternative to gun launched weapons. It uses advanced propulsion material and laser guidance methods to accelerate a long rod heavy metal penetrator to very high velocities. The guidance system for both ground and air launched versions of HVM will be tested this year at stand-off ranges. This program also has multiple applications. By replacing the penetrator with an appropriate warhead, a ground launched HVM has potential as an air defense weapon.

### O. Underseas Weapons and Targeting

Technology is being developed to counter a rapidly expanding undersea threat posed by the deployment of new Soviet submarines exploiting advanced technologies. Among the efforts underway, the Navy and DARPA are jointly developing undersea warheads using entirely new concepts. Also, the Navy has joined with the Department of Energy in a program to take advantage of their expertise and computer modeling resources to develop warhead concepts for use in the next generation of undersea weapons. These efforts along with a number of new undersea sensors and torpedo product improvements will enhance the ability of the Navy to operate effectively in an underseas environment.

### P. Training Technology

As training of both active and reserve forces is a major peacetime activity, it is important that it be done well and at acceptable cost. Technology advances in computer software, electroluminescent displays, voice synthesis and recognition and computer generated imagery make possible a range of options for increasing training effectiveness. For the maintenance technician, a portable training and job aid device will be demonstrated. This briefcase sized device will weigh less than 30 pounds and could replace, if needed, approximately 25 linear feet of manuals and instructional material. In addition, the development of lower cost visual systems will be emphasized so that visual scenes can be used in more simulators. Realistic and affordable visual scenes are one of the key components of a wide range of training simulators. Training is a major DoD expense and technologies to make training better and more cost effective must be exploited.

## IV. SUPPORTING TECHNOLOGIES

The DoD S&T program encompasses supporting activities that are of importance to the mission organizations, to the performing R&D organizations and to the general well being of military installations. Several of these topics are discussed below:

### A. Environmental Sciences Research and Global Environmental Support

Meteorology, oceanography, terrestrial science and space science are major military considerations that are discussed under environmental sciences. This program is developing methodologies and equipment to optimize the performance of existing and emerging systems, sensors and platforms. Environmental situations can limit or even render inoperative many systems and sensors. Hence, it is important to incorporate environmental considerations in designs so that potentially adverse conditions can be avoided, mitigated, or exploited.

Research in environmental sciences tends to emphasize tactical support situations that involve tactical decision aids (TDA). TDAs use environmental and other available data to give on-scene commanders current information upon which to base tactical decisions. In the Army, for example, the Air-Land Battlefield Environment (ALBE) program develops environmental instrumentation and models to transform raw data into TDAs that can be used by commanders and their staffs without further interpretation. Both the Navy and the Air Force have similar efforts oriented toward Service-unique requirements. There is inter-Service cooperation wherever commonality exists.

In a macro sense, DoD's central data processing facilities have been upgraded with the CYBER 205 at the Navy Fleet Numerical Oceanography Center and the CRAY XMP at the Air Force Global Weather Central. In satellite technology, planning for a new generation of the Defense Meteorological Satellite Program is underway and the Navy is preparing to launch the Navy Remote Oceanographic Satellite System by the end of the decade. These are outstanding improvements, but they are only a beginning. The environmental sciences R&D program must be continued to provide tactical units with modern capabilities to meet current and future operational requirements.

## B. Scientific and Technical Information

The S&T program and R&D in general requires an effective exchange of technical information. This is accomplished primarily by the Defense Technical Information Center (DTIC), Information for Industry Offices (IFIOs) and specialized Information Analysis Centers (IACs). DTIC maintains data bases on planned DoD research projects, summaries of technical work in progress, reports of completed R&D efforts and descriptions of industrial Independent Research and Development projects.

The Information for Industry Offices were established to permit industry access to information on DoD acquisitions, R&D requirements, plans, and future needs. At these offices, industry can review operational requirements, S&T objectives, and other planning documents relevant to the R&D capability of their respective organizations. The IFIOs have been most useful to contractors for planning their IR&D programs.

The Information Analysis Centers collect, review, analyze, summarize and provide advisory services in well-defined specialized fields. IACs are distinguished from documentation centers and libraries, whose functions are primarily concerned with collecting and disseminating documents, by their concern with technical information contained in the documents. A Chemical/Biological Defense Information Analysis Center is being established and a High Temperature Materials Information Analysis Center is being created by reorienting the mission of an existing IAC. Information Analysis Centers continue to provide a valuable support function for the scientific and engineering community.

DoD laboratories have become increasingly involved with state and local governments and the private sector to improve the transfer and exchange of technologies and expertise. These technologies are transferred through consultations and assistance provided by the laboratory engineers and scientists in their areas of expertise. This is an important aspect of DoD's role because it is important that wide use be made of federally developed and sponsored R&D as encouraged by the Stevenson-Wydler Act.

### C. Environmental Quality Technology

Environmental quality R&D is underway to assess the impact of activities on the environment and to develop equipment and techniques that meet both environmental standards and military requirements The DoD program is oriented toward aircraft, missiles, ship wastes, and industrial type operations that are unique to the DoD. Specific functions performed include environmental and public health effects, monitoring, management, assessment and planning. Also, included are pollution reduction, control, and treatment technologies. Programs are directed toward achieving new and more cost-effective technologies, adaptation of best available technology, or development of new technology if required for national security activities.

The DoD program is directed toward unique military operations and needs. However, to assure an awareness of all technology application available for DoD needs, a Memorandum of Agreement (MOA) has been established with the U.S. Environmental Protection Agency. In addition, the individual Services maintain MOAs in specific areas of interest. The DoD-wide program is managed via a detailed coordinating paper in addition to the normal staff and command mechanisms. This coordinating paper is exchanged with other Federal agencies that have an interest in environmental R&D.

In the environmental quality program, missile and shuttle exhaust cloud models for monitoring contaminants have been completed. A waste water treatment to destroy hydrazines also has been completed and an automatic aircraft sonic boom monitoring system has been developed. Also, the evaluation of trash compactors and incinerators designed for shipboard use will provide essential tools for modern naval operations. These programs are fulfilling the need to minimize pollution problems in military operational and industrial environments as well as making DoD a good neighbor and in conformance with standards applicable to the processes involved.

## V. CONCLUDING REMARKS

It has not been possible to cover all technologies in these discussions. In addition to topics discussed in the statement, promising opportunities are being explored in the non-medical aspects of biotechnology, research to increase the efficiency and reduce costs in logistics functions, robotics and manufacturing sciences. The program is balanced to cover these and other revolutionary and evolutionary technologies essential for modernization of future forces.

The Department is committed to ensuring that the S&T program is maintained at a viable level and that it will continue to be performed by a combination of industry, universities and

DoD in-house laboratories. It is our view that this broad innovative base has served the country well and we will continue to depend upon it for the concepts, equipment and techniques needed for continued U.S. national security strength.

Your continued support of DoD S&T goals is appreciated.

## APPENDIX I

### Science and Technology Program History
(Dollars in Million)

| Fiscal Year | 6.1 | 6.2 | 6.3A | Total |
|---|---|---|---|---|
| FY-77 | 373 | 1,305 | - | - |
| FY-78 | 413 | 1,389 | 472 | 2,274 |
| FY-79 | 475 | 1,535 | 525 | 2,535 |
| FY-80 | 553 | 1,718 | 604 | 2,875 |
| FY-81 | 615 | 1,986 | 606 | 3,207 |
| FY-82 | 697 | 2,233 | 759 | 3,689 |
| FY-83 | 786 | 2,457 | 834 | 3,877 |
| FY-84 | 843 | 2,211 | 1,410 | 4,464 |
| FY-85 | 852 | 2,268 | 1,363 | 4,483 |
| FY-86 | 1,024 | 2,425 | 1,488 | 4,937 |
| FY-87 | 986 | 2,599 | 1,790 | 5,375 |
| FY-88 | 1,080 | 2,839 | 1,956 | 5,875 |

Notes: 6.1 - Research
6.2 - Exploratory Development
6.3A - Advanced Technology Development less Strategic Defense Initiative.
Does not include Gramm-Rudman reductions.

Mr. PRICE. Mr. Dickinson.

Mr. DICKINSON. Thank you, Mr. Chairman.

We are very pleased to have you here on your maiden flight, so to speak. We appreciate your statement. There are a couple things I would like to ask you.

I assume from what you say you are committed to the National Aerospace plane, or whatever, and I would like to know a little bit more about it. President Reagan said this thing will be great, it will take off from existing airport runways, if we are talking about the same thing, and I think we are, and will get you to Tokyo in 2 hours. I don't know who wants to go to Tokyo in 2 hours.

Mr. DAVIS. Getting back from Tokyo in 2 hours. You know, we went through a great—those of us who have been around long enough to remember, we went through a great deal of turmoil here on the SST concept, and Congress ultimately killed it. Then the French and British went forward with it, with the Concord, and it has not been financially viable. It is a prestige-type thing, but it was smaller than what we had envisioned. It doesn't carry enough people to make it viable financially.

Are we talking about another type of plane here that will hit the same type of problems we are talking about? Because if we are, until we have a change in people in the Congress, it is not going to be sold. We are not going—if you are talking from point to point in the world, on the Earth is one thing, if you are talking the United States to some place in space, that is a different thing. Can you give us a little discussion of that?

Dr. KERBER. What we are looking at is a program to see if the technology we have and that we can develop toward this goal will be sufficient to develop an experimental-type vehicle. The kinds of technologies we are looking at are in the materials, structures and propulsion area. We think there would be uses for this kind of vehicle, and that is why you heard about it in the President's speech, the things you have mentioned.

Basically this program is to flesh out the technology to see where we are and if we can do it. It looks like, at this point, that the technology is in place and can be further developed over a few years so that we can commit to an experimental-type vehicle. It would have certain definite advantages. If we go the whole route, we could end up with a higher fraction of the liftoff weight going into the payload in orbit, for example. It is not an SST, but it is a plane that would take off horizontally and could go into orbit. This program is not to develop a plane. This program is to develop the technology to see if that is feasible.

Mr. DICKINSON. Well, I appreciate that information, because I think that is important. You are not developing the plane, per se, the vehicle, but the technology to improve the ability to do such a thing. What are we talking about in terms of money and time?

Dr. KERBER. This fiscal year we have from the DOD side about $150 million. This funding is in Air Force, DARPA, SDI and Navy budgets. Also there is a 20 percent fiscal contribution by NASA. The program goes out for a few years. There is a decision point of whether it is prudent to develop an experimental vehicle or not. We are currently working very hard to establish a coordinated plan so that we can make that decision.

Mr. Dickinson. We have a very difficult decision here in the Congress. Do we want to spend that much money for what we are talking about in view of Gramm-Rudman and the other major cutbacks in social programs, as well as military programs, to put that sort of money—you are talking about a 1-year budget figure, and we are looking at the outyears, and you haven't given us that.

But, you know, it does give us a real problem here. Is this the time, can we afford what we are proposing to do in view of the other cuts that we are having to take of additional type things, social programs? I think we have a real tough time.

Let me ask you one other question.

Dr. Kerber. Could I respond to that?

Mr. Dickinson. Yes, please.

Dr. Kerber. I think we are talking about a missed opportunity if we don't proceed. The technology is in a position where it is prudent to go ahead and take a very hard look at this concept. We are facing many needs to put things efficiently into orbit. If we can, for example, increase by a factor of 5 or 10 the ratio of payload weight to liftoff weight, we have made a very significant contribution to the goals of the country.

Mr. Dickinson. I read in the paper—whether it is true or not, you know, you don't know what is true in the Post—that the proposed plane will reduce by one-tenth, 10 times, what it costs to put an object in space by weight. Is that about right?

Dr. Kerber. That is approximately correct.

Mr. Dickinson. If we could develop this, we could cut the shuttle liftoff and launches and so forth by 90 percent, one-tenth at least what it would cost otherwise. I assume, then, we are getting into a market where we are being competitive with the French and others who are putting objects in space. Maybe this is a big factor, I don't know.

Dr. Kerber. I was just briefed yesterday on a program the British are looking at and they are hoping to sell it to the Europeans. It is an international market for technology now.

Mr. Dickinson. I will cover other questions, but let me yield to the chairman and Mr. Davis, and then I will come back.

Did you have a question, Mr. Chairman?

Mr. Price. Any other questions?

Mr. Davis. Yes. Thank you, Mr. Chairman.

I want to talk about the URI Program for a minute. We authorize and appropriate, I think, $100 million for this program in 1986. Is that the right figure?

Mr. Battista. That is what finally got appropriated, plus the rest of the other Department request.

Mr. Davis. Of the $100 million, can you tell me how much has been actually committed or spent? And, also, the administration is requesting only $50 million, 50-percent reduction, and what kind of effect is that going to have on the URI Program by cutting it?

First of all, how much have we allocated or committed of the $100 million, and what effects is a 50-percent cut going to have on the URI Program?

Dr. Kerber. In answer to the first question of how much have we committed, we currently have announcements on the street which means that we have advertised through the Army, the Navy, and the Air Force for this program. DARPA is also a participant. They will be using the Navy for administration of their program.

February 28 was the deadline for proposals to be received by the Army. April 15 is the deadline for proposals to be received by the other services. There has been no money committed at this time for URI. This is an activity that is coordinated through my office. We are interested in making sure the interests of the services are met relative to the programs that will be funded in URI. We will have common review committees, such that there will be a representative from each service on the other service's review committee. We have coordination by technical areas. We are working that problem very hard.

With respect to the second question, we received the money or the appropriation in December 1986, and, we haven't procured anything as yet. As we looked at this program and the time scale that was evolving, it was prudent to consider that we had $100 million that is not likely to be in final contract until either early or late summer of 1986. In addition, another $50 million, as you have correctly noted, would be available for fiscal year 1987.

So, basically, we are looking at five quarters, or slightly more, to spend $150 million, and that is why we made the decision not to raise the $50 million. Next year we have $100 million planned, and we are committed to the program and supportive of it.

Mr. **Davis**. I would assume that you will have proposals which will offer a lot more than $100 million.

Dr. **Kerber**. I am certain you are correct.

Mr. **Davis**. So you probably won't have any trouble finding places to put it.

My next question is, SDI money has or is being committed for research in many of our colleges or many of our universities. My question is, will any of this money, the $100 million or $150 million, be used for SDI research, or is it limited?

Dr. **Kerber**. We have established, as we were talking about earlier, about 10 areas that are primary targets for this research. The areas that are associated with the research are possibly of interest to SDI and possibly not. They are general interest areas to DOD.

For example, I can see that some of the basic research conducted in control systems may be of use to SDI. We have very strong coordination between USDR&E and SDI. This program is not set out to serve SDI.

Mr. **Davis**. Let me follow up with one more question on SDI. I assume we will find that a lot of the money that is spent in SDI research will have some spinoffs for other military applications and perhaps civilian. Can you discuss that?

Dr. **Kerber**. Certainly. There are many areas where there will be spinoffs. One area near and dear to me is the laser area. I noted on coming over here that there is a little over $800 million in SDI for laser-related research. There is about $40 or $50 million of money in the other parts of DOD for laser-related research for tactical systems. Obviously we will spin off the SDI funding for any laser research that might be appropriate for tactical areas.

In command and control and those areas, SDI is developing a significant amount of technology that will be of interest to DOD in general. In materials development and development of high-temperature materials, protective coatings and various activities like that, we will find many uses for those in the rest of DOD, so to speak. It turns out that any time you have technology that is really pushing the state of the art, there are many spinoffs that are good for a wide range of areas.

Mr. DAVIS. No more questions right now, Mr. Chairman.

Mr. PRICE. Mr. Dickinson.

Mr. DICKINSON. I have one more; I am looking at the 1986 congressional set-asides for your department. I assume that is what this is. We have as a budget beneficiary of R&D Wichita State, Las Vegas, Nevada, Iowa State, Northeastern University, Oklahoma, Syracuse, Cornell, Rochester, adding up to some $65 billion. I don't know if these are arrived at competitively or not, and I was just wondering if you can tell me how do you get around to deciding where these grants go? I don't see Auburn, for instance, represented here, and I was just wondering how do you come to the conclusion who gets part of this $65 million awarded last year and who will get it next year?

Dr. KERBER. These were items that were in the fiscal year 1986 conference report of the Appropriations Committee.

Mr. DICKINSON. You are saying the Appropriations Committee, then, allocates these specific colleges?

Dr. KERBER. These were specific allocations that were made in the conference report. These were not determined by the Department. These particular actions do cause us a significant problem relative to maintaining a competitive merit system in university research. I have spent an immense amount of time talking to university presidents who are upset about this kind of activity.

Mr. DICKINSON. I am too, if the Appropriations Committee is going to be the sole arbiter of who gets the funds. From what I understand you to say, they are the final authority as to where these funds are channeled, and DOD, DARPA, or whatever, doesn't select these. Are there other funds other than those that I have mentioned?

Dr. KERBER. There are other funds in other agencies. There are—in what we call set-asides for fiscal year 1986, approximately 230 million dollars' worth of set-asides. We have $65 or $66 million of that. Of the $65 or $66 million, about $37 million is for construction. We are told by counsel that we have no legal way to use R&D funds for these purposes.

Mr. DICKINSON. Does this come out of our military construction authorization on appropriations, or what?

Dr. KERBER. No, it does not; it was in the RDT&E budget.

Mr. DICKINSON. We are talking brick and mortar money out of the R&D budget.

Dr. KERBER. It is a significant problem for us. We have talked to every university. We had teams go out to each university to see what might be prudent for the Department to do relative to the proposals of the university and the needs of the Department. In every case, we have looked at that carefully and are still trying to determine what is the best approach.

Mr. DICKINSON. Well, on the surface at least, it seems inequitable and, well, the use of special authority, as well as taking away from the process that we have set up here, if a large portion, as you said, about half, goes into bricks and mortar type things out of R&D, which is directed by the Appropriations Committee over which we have no say so.

I think that really is an area that we need to look into a little more, with a great deal more care. I am surprised at what you are saying, if that is a fact.

Dr. KERBER. I would like to comment on that just for a minute. As I mentioned to you when I started this, my part of the presentation for the hearing, that I have only been in this position for 10 weeks or so. I have been on the other side of the fence and I have dealt with, and I think all of my colleagues have dealt with, the merit system and we are very happy with it. It is a system that has built the Science and Technology base of the country to the preeminence that it now has. So to deteriorate that merit system by various set-aside actions is a significant danger that we are faced with.

We know our current system works, and I would suggest we don't tamper with it.

Mr. DICKINSON. Let me make sure I understand what you are saying. You are saying that these instances that I have enumerated here are a deviation from what we have traditionally done?

Dr. KERBER. That is absolutely correct.

Mr. DICKINSON. It is this your objecting to?

Dr. KERBER. That is absolutely correct.

Mr. DICKINSON. OK, we are on the same wave length. Thank you. Mr. Davis.

Mr. DAVIS. Let me follow up, Mr. Chairman. I guess I wasn't aware of this. This happened——

Mr. BATTISTA. The situation is pretty bad, Mr. Davis. The university research initiative got started really as a consequence of our investigation of the industrial base. And what we found—Mr. Dickinson was on that panel. It was headed by Dick Ichord of Missouri. We found we not only had an industrial base problem, we had a declining academic base. So, accordingly, we took the Department's request last year and plussed it up, if you remember, $200 million, and that was for several purposes.

The first was to encourage more American students to go to graduate school. Our graduate school population was some 50 percent foreign nationals in many instances, and then they take the technology back home. We wanted to encourage more U.S. students, more grads to go to grad school.

Second, we found many of our laboratory facilities in the universities were 20 or more years old and that we should modernize our lab facilities.

Third, we found a lot of our researchers would only call upon the high technology work after they graduated. We wanted to get VHSIC technology and laser technology into the university complex. We wanted to make money available for grad students to be exposed to high technology before they got to industry.

What happened was by the time this initiative got through the appropriations cycle, it became highly politicized. Now we are not only directed which university is going to get money, we are politicizing the university environment, and I have had an increase from schools saying: "How do we play the game?" Now we are using R&D funds, which are precious enough for brick and mortar. What we are doing, and you will hear from Dr. Rosenzweig, I think we are undermining the whole program by these directed appropriations and tasks to specific colleges and universities.

Mr. DAVIS. That, to me, is dumb. The whole idea and the way this program should work, it should be a merit system, it should be a competitive system, and we should let the Department of Defense and the various agencies therein make the decision where in the heck the money should go. This is ridiculous, to earmark those moneys for 10 universities.

Can we put language in the authorization bill—I don't know whether we can undo what has already been done—but to see that doesn't happen, leave it on an open, competitive basis? I mean, that is the way you get, you know, good programs, good offers, and that is just ridiculous. I didn't know that had happened. That is a terrible thing.

Mr. DICKINSON. If you will yield, there are two areas of abuse here, it seems to me. One is that the Appropriations Committee is directing and channeling the funds over which we have—in their bill and language report, these are the schools that are going to be the beneficiaries.

Second, they are taking R&D funds, which they may not authorize, and a big portion, about half, according to this, goes to construction, brick, and mortar-type things. This is not the intent of this committee. So these are the two areas of abuse, I think, and I have no reason to think we couldn't put language in the bill, as well as working in conference to see that this area of abuse is not——

Mr. MCCURDY. A point of order should lie against any amendment against any appropriation unauthorized, should it not?

Mr. DICKINSON. This is in report language. They have done this in report language, which we never even get to look at.

Mr. MCCURDY. I agree. I think we are saying the same thing. The gentleman from Georgia, who is not here, and this gentleman, you know, if we are going to get in that game, there are a couple of States that would be on that list that are not there, so that is not the game we want to play either. It ought to be competitive based on a different system, and this is absolutely asinine, how we craft legislation.

I think you are right, we need to provide specific direction authorizing how the money is distributed so that they cannot come in and earmark it, $10 million, for a library at some university in somebody's State.

Mr. DAVIS. We are trying to find out a way to undo what has been done, and then draft language in here——

Mr. MCCURDY. Does someone have a report of that? Do we have an actual itemized accounting of how that money——

Mr. DICKINSON. Yes. We just went through that.

Mr. BATTISTA. If you so direct, we will ask the general counsel——

Mr. DAVIS. I think we should direct our staff to do whatever is necessary.

Mr. DICKINSON. Absolutely.

Mr. PRICE. We can take care of that.

Mr. Dickinson. We are sorry to take all this out of your time, but, I think, it is something you feel strongly about, and we do too.

Mr. Kerber. It is an important issue, I am glad you are addressing it. If you don't address it, we will have major problems.

Mr. Price. Mr. McCurdy, did you have any questions?

Mr. McCurdy. No, sir. Thank you.

Mr. Price. Mr. Battista has a couple.

Mr. Battista. Dr. Kerber, no reflection on you, because you have only been in the job 10 weeks, but if we go back over history, and the names Carter, Davis, Weisberg, and Allen come to mind, and that is not a law firm, those were your predecessors, and we keep hearing about all the good things that come out of technology. You alluded to our fighting capability or deterrent capability in your statement, but yet we go out to the field year in and year out and get the same message. We can't sustain a prolonged conflict in NATO, we have got the technology, but somehow we can't get it out to the guy who really needs it.

In 1982, Secretary Weinberger talked about all this emerging technology that we had; in 1983, the President in his March 23 speech alluded to the fact we had the technology in hand right now to greatly enhance our conventional deterrence posture. I don't know who the head of the conventional defense initiative is, I know who the head of the strategic defense initiative is, but, quite candidly, your office has always been very quick to point out how good you are, but we can't find what you have done for the combat forces lately.

Why should you continue to be funded if, in fact, we can't get this stuff that is very valuable into the hands of the user? And I know you can give me several examples of VHSIC and lasers and things like that, but a lot of these things were congressional initiatives. VHSIC came out of this committee. In fact, it was started with Dr. Weisberg back in the late 1970's. What is the problem, why can't you seem to make this transition? Is it NIH among the services, that attitude?

Dr. Kerber. I don't think so. I think we are, at least from my 10 weeks—one of my goals has been to emphasize technology transition. As you know, I spent a time at DARPA where we have to work that problem very hard because DARPA is not part of one of the——

Mr. Battista. You had to work it too hard, didn't you?

Dr. Kerber. It is important to work it hard.

Mr. Battista. It shouldn't require that level of effort. The services should be very willing to take on your products, because they are going to enhance our warfare and fighting posture.

Dr. Kerber. We need to work with them at the conception of an idea so they are part of a team. I have emphasized in my first 10 weeks that it is important that we work with the services at the start of a concept. When we have an idea that we think is worth transitioning, we are going to work aggressively with the services so that it is transitioned.

The services have their problems. Everyone has his day-to-day problems. They are putting out fires constantly. What needs to be done by people in the technology area is to make sure that that technology is made available to the people who use it. I think we have to work aggressively toward that goal. If I could do that during my tenure, I would have made a significant contribution. I think it is very important.

If you will look at my opening statement, that was in there. I believe it is a significant area that we can work.

Mr. BATTISTA. Let me ask you about one other area. In-house laboratories, we have got some that are not so productive and some that are very productive. I look at channel and sea radar, antiradar coming out there. I look at our air-to-air missiles. Sidewinder, Sparrow—all these things emanated from the in-house lab. Laser technology grew out of an in-house effort, infrared out of an in-house effort with industry.

How do you feel about the in-house laboratories? Are they worth sustaining? The perception up here is that we get a lot of good things from them, and they make the Government a smart buyer.

Dr. KERBER. I think we need to improve those areas you alluded to that need improvement. Yes, they are worth maintaining, to be precise. They are a critical part of developing technology and of procuring technology. Where we have deficiencies, we need to work on that.

One area I can cite in particular is the way we handle manpower in the labs now, it is causing significant problems relative to keeping qualified people. I spent a short stint at the weapons laboratory, and of the people that I thought were outstanding, five of the six are now in private industry. That is the reason we need to work on our personnel system so that we can aggressively keep top people in the laboratory environment.

We have been working on a personnel system that will be much more flexible. For example, we are looking at maybe four or five categories for the personnel versus the more detailed levels we had before. A person can transition in a category based on merit much easier than in the present system. We need to do things that are creative to keep the top people in the labs or else we will continue to have questions from you like this.

Mr. BATTISTA. Well, how are you going to bring this about since your boss has been very vocal in saying he thinks the in-house lab system is a waste of time, they ought to be shut down? He said that, not in gist, on more than one occasion. So how are you going to make this happen? You have been in the job 10 weeks, we would like to see you continue in the job. I don't know how you are going to answer this, but he is extremely hostile toward the in-house lab system.

Dr. KERBER. Dr. Hicks and I are working together on all the——

Mr. BATTISTA. You are working to make them better, and he is working to shut them down. Where are you going to meet?

Dr. KERBER. All of this is a perception, but I will tell you from my perspective, I am going to work hard to improve those laboratories.

Mr. BATTISTA. Last question. We have got technologies that are in the, let's say normal category of presentation to the Congress, to the public. We have got the same technologies, not quite as good, in special access compartments. I suggest that a lot of the technologies we have got in the special access compartments are only there for political reasons and not for national security reasons.

You are asking for a $1 billion increase in this year's budget. Let me ask you, do you know how many millimeter wave guidance programs you have got in the DOD right now, all in the same two frequency bands?

Dr. KERBER. First let me answer the first part of the question that said we have over a $1 billion increase for this year.

Mr. BATTISTA. Yes, over last year in the entire technical base. Didn't you get $4.6 billion last year? And you are asking for——

Dr. KERBER. We had $4.8 or $4.9 billion, and the there was a Gramm-Rudman cut. This is not a $1 billion increase.

The second question is relative to the number of programs we have in the millimeter wave technology area? .

Mr. BATTISTA. Yes.

Dr. KERBER. I think it would be best, since I don't know the details to provide an answer for the record.

[The following information was received for the record:]

### MILLIMETER WAVE GUIDANCE PROGRAMS

Millimeter wave programs are defined as those that operate in the region of 30 to 300 Gigahertz. There are nine millimeter wave guidance programs, including both classified and unclassified efforts, being pursued at the technology demonstration or higher level. Only two of these will be funded in the FY 1987 Science and Technology program. The remaining programs are funded under other budget activities.

In addition to normal management procedures, millimeter wave component developments are formally coordinated via the Advisory Group on Electron Devices. In addition, Technology Base guidance efforts are coordinated via the Joint Services Guidance and Control Committee. The Department intends to continue strong management of millimeter wave activities to preclude unwarranted duplication and to ensure future DoD needs are being achieved.

Mr. BATTISTA. OK. If you could go back and take a long, hard look at all the other technologies you got for which you got a half dozen or more efforts ongoing all to accomplish the same goal. And it is true that in some areas, you might want a different approach; where there is high risk, you would like to have labs taking different approaches, but not to the extent that I have looked at in this year's budget request. We have got so darned much redundancy and duplication of effort there and at a time when you have Gramm-Rudman, I would hate to see us shortchanging areas we ought to be emphasizing because we have so much duplication. If you can take a look at that and let us know, because we are on a short fuse.

Dr. KERBER. I will certainly do that, although I would caution you, and I am sure you are well aware, that many programs that look alike from the title on a PE aren't alike when you get into the guts of it.

Mr. BATTISTA. We go a lot deeper than what you have on the PE. If we just went by the PE, you might only get a fraction of your budget request.

Dr. KERBER. I tell you, we will look at it.

Mr. PRICE. Mr. Bayer has a question.

Mr. BAYER. We talked about this before the hearing, but you pointed out the Army has $1.4 billion in their tech base. That is 25 percent of their R&D budget. The Navy has $1 billion, which is 10 percent of their budget; the Air Force, $1.6 billion, which is about 9 percent of their budget. There seems to be quite a disparity there. We are looking at the Army putting 25 percent of its R&D in the tech base and about 50 percent of its budget is going into actual systems development.

Could you elaborate on the utility of that approach?

Dr. **Kerber**. I think all the Services are looking at their technology needs in the tech base. What you are seeing is a difference in what is currently in, as far as engineering development, our development of advanced systems, at this time. So you are looking at the ratio relative to their basic technology needs.

Mr. **Bayer**. Not only the ratio, but they have a dollar level almost equivalent to the Air Force. Air Force has a $17 billion R&D program, the Army has a $5.5 billion. They both have about the same dollar level in the technical base.

Dr. **Kerber**. Since Don Carter has been here longer than I, perhaps he could answer that question.

Colonel **Carter**. I think if you look at the size of the engineering development programs in the Air Force and in the Navy, they are very high. But those change as a function of time. A couple years ago, the Abrams tank in the Army was a big user of 6.4-type funds. So it fluctuates, the percentage fluctuates a little bit, depending on their total R&D in the account. If one looks at the total DOD Science and Technology Program, the percentage stays relatively the same, at about 2 percent, something like that.

Mr. **Price**. Thank you very much, gentlemen. We appreciate your cooperation with the committee.

The subcommittee will now hear Mr. Robert Rosenzweig, president of the Association of American Universities.

## STATEMENT OF DR. ROBERT M. ROSENZWEIG, PRESIDENT, ASSOCIATION OF AMERICAN UNIVERSITIES

Mr. **Rosenzweig**. I appreciate your invitation to appear here today. In addition to the Association of American Universities, I appear here on behalf of a group of other associations whose members contain substantially all of the basic capacity in the Nation, as well as the Nation's capacity to train scientists and engineers to the highest educational level.

Before I get to the main point of my brief remarks this morning, I would like to start by underlining several of the main conclusions of the prepared testimony, which I have entered for the record. Four points in particular, Mr. Chairman.

First, we think there is a need to restore the balance between the expenditures in the 6.1, 6.2 programs and the total RDT&E effort. Those two weights have gotten out of balance in the last 4 or 5 years. Technology expenditures on programs have expanded rapidly, while basic research and development have not, and in the not very long run it seems to us that that latter fact will defeat the purpose of the former, and it would be timely to bring those two more closely into balance.

Second, we urge you to sustain the university research initiative and authorize it at the $200 million level that you put in last year. I don't have an informed view of the management circumstances within the Department that have led it to stretch out the expenditures for that program, but I can assure you that there is no shortage of important uses for that money in the universities, and if the Department can be helped to put its management problems in order, I think it ought to be possible to use the level of appropriations that you authorized last year. And we are urging you to reauthorize this year for this program.

Third, we think that you should address the facilities and instrumentation problems directly. There is a serious problem of laboratory renovation and modernization that needs to be dealt with and that the Department is not now and hasn't been in a position to deal with. We would like to see the Office of the Secretary be given authority to assist in laboratory modernization, and we would urge you to continue the authorization for the university research instrumentation program, which has been extraordinarily valuable for a relatively small amount of money.

And, finally, and growing out of the preceding three points and others, perhaps, in 1981 this committee asked the Defense Science Board to take a look systematically at the relationships between the Department and the universities and to make recommendations on how those relationships could be improved. That resulted in a report in 1982 which has had some quite useful spinoffs, or results, I should say, including the creation of the DOD University forum and perhaps a creation of the university reserved initiative itself.

It seems enough has happened since 1982, when that report was issued, to make it timely for you to ask the Defense Science Board once again to take a look at that relationship and see if there are further constructive changes that can be made in it that would benefit both the Department and the universities.

Those are the main recommendations in my prepared testimony, Mr. Chairman. I just wanted to make sure that they were underlined for your benefit.

My particular purpose in appearing here today, I judge from the earlier conversation which I listened to, may come under the heading of preaching to the choir. However, I am not aware of any preacher who has ever stopped a sermon for that reason, and I don't know why I should be the first one. So let me talk to you about a subject that was discussed earlier.

This has been a very successful relationship on the whole between the Department of Defense and the universities, and, in fact, I think it is not unfair to describe it as one of the genuine achievements of American policy in the postwar years. One of the reasons for the success of that relationship is under threat now, and I think it should be of great concern to you as a committee. I refer to the fact that the continuing resolution for fiscal year 1986 appropriated funds throughout the Department of Defense for 10 separate projects involving research or research facilities, with a total value of $65.5 million.

To put that number into perspective, it is more than half the amount appropriated for DOD's university research initiative. I want to talk more about than simply the number of dollars involved. Far more important is not one of those projects had been submitted to the professional review which the Department customarily applies to projects it supports, and not one of them has been considered for inclusion in the plans of any of the Department's research agencies. Indeed, they sprang full blown from the brow of the continuing resolution, bypassing all scientific review, all other departmental processes and all congressional processes as well.

Even with all that, why should you be concerned? In fact, I would say alarmed, after all, it might be argued—some do, though—the decision processes might not have been the best, some of the work done in some of those projects is likely to be quite good. In all cases, there is likely to be some economic benefit to the community involved.

I would suggest that the reason for your concern is that we are seeing the guarantee of mediocrity being built into America's research capacity by actions that turn away from assessment of quality made by those best able to judge as the primary criterion, the threshold judgment, if you will, for the support of research.

I am well aware no scheme for making decisions is immune to error, but it seems to me clear that one that does not strive for quality as its preferred outcome will not achieve quality. For 40 years, the decision processes of DOD, NSF, NIH, and others, have put quality first by subjecting research proposals to the review of competent scientific professionals, and the result has been the growth of the most productive enterprise of basic research and research training in the world.

A few years ago, we began to see signs of restlessness with that system and turning away from it. In response, virtually every major educational and scientific group issues public statements urging adherence to proven systems of judgment, and I have attached a number of those statements to my testimony for the record.

At first the projects approved through earmarked appropriations were research facilities, testimony, no doubt, to the real stress caused by 15-year absence of Federal funds for the support of research facilities. It was argued then buildings are different from actual research projects, but Congress always takes a hand in deciding where a building should go, but there was no reason why decisions about what research should be conducted, by whom and where should be affected in any way.

I confess that that argument always had, to me, a certain self-serving quality to it. It is substantially wrong on the facts. To a degree, the Congress has refrained from involvement. Moreover, it has always seemed to me clear if decisions about research facilities begin to be made on the basis of who has the most influential Congressman, there is no hope of insulating the rest of the system from that decision rule.

The 10 proposals approved in the continuing resolution are dramatic proof of that. Included among them are projects purely and simply research and not facilities at all. I don't know how they would have stacked up against others in a fairly judged competition, because there was no competition and no judgment. So as far as the quality of the research is concerned, the people of the United States were sold a pig in a poke, and that is not good enough.

Mr. Chairman, we have learned some things in the 40 years during which we have built the world's most productive research capacity. We have learned, for example, when research and training are done together, each is better than when they are done separately. We have also learned secrecy throttles creativity, and when we impose it on ourselves, we are likely to do ourselves great damage.

Not the least of the lessons to be taught by the last 40 years of experience is that supporting less than the best research of which we are capable is enormously costly and self-defeating. In research, indeed in the life of the mind generally, quality really matters. The distance between the best and the second best is the critical difference, and to sacrifice the advantage it bestows would be to give away one of the real advantages we have as a Nation. That last lesson has never been more important than it is now. It has never been true we were smarter than our competitors, and it is no longer true that they are disadvantaged by the devastation of a war which required more than a generation for winners and losers alike to recover.

What we still have that enables us to compete successfully is a set of institutional arrangements and practices that recognizes, nurtures, and rewards high-quality people in their work. It may seem exaggerated to suggest that 10 projects adding up to $65.5 million represents such high stakes. By themselves, of course, they do not. But by what they might well foreshadow, they constitute an ominous threat. If they point the way to a growing proportion of funds—if they point to the way, a growing proportion of funds for science will be awarded.

Then I would suggest we are witnessing a fundamental change in a key aspect of our system. The mutual self-restraint which has largely marked this area of public policy, a restraint in which universities forego the use of political influence and Congressmen refrain from exercising it is an essential foundation stone of the commitment to quality. If it is eroded, the commitment to quality will be eroded, and the result can only be a lowering of the quality of American science.

I urge you, Mr. Chairman, as you work through the budget in this difficult year, to be alert to efforts that would make something other than the quality of the work to be done the determining factor in decisionmaking about scientific resources. I can assure you of our help in that important job.

Thank you, Mr. Chairman. I would be pleased to answer any questions.

# Prepared Statement of Dr. Robert M. Rosenzweig

Mr. Chairman and Members of the Subcommittee:

My name is Robert Rosenzweig. I am President of the Association of American Universities, an association of 56 major research universities. I also am representing four other higher education associations, many of whose member universities and colleges are deeply involved with, and concerned about, the fundamental research and training programs of the Department of Defense. On behalf of us all, I want to express to you our gratitude for the invitation to join you again for a discussion of the Department's academic science and related university programs and the FY 1987 DOD Authorization.

For several years this Subcommittee has given sustained leadership to a fresh examination of the capabilities of research universities to meet our national security requirements. The hearings you have conducted during each of the past five years are a constructive inquiry into the health of our defense-related research and training base. The Subcommittee has paved the way for many recent improvements in DOD university programs, including the University Research Instrumentation Program, the creation, last year, of the promising University Research Initiative; and the establishment of the DOD-University Forum as an advisory committee to the Department. We congratulate you, Mr. Chairman, and the Members and staff of the Subcommittee for your persistence and your leadership.

## This Is Not An Ordinary Year

I cannot recall a year in which budgetary matters were so filled with uncertainty, in which the whole process seemed headed toward a destination which no one in it could foresee, and in which the possibility of serious damage to important social institutions seemed so real.

It is against that backdrop that I want to discuss the FY 1987 DOD university research budget. If this were just another year, I would, as in previous years, address the Department's university research budget as if it stood alone and could be dealt with substantially without regard to other matters which you, as Members of Congress, will confront. In this year, however, I do not believe that the DOD budget for research and university programs, or perhaps any other budget, can be considered by a Congressional committee without regard to responsibilities of the Members that go beyond their subcommittee and committee assignments and the agencies within their jurisdiction.

This is not an ordinary year. What most marks off this year from others is a pervasive sense of vulnerability that makes even good news suspect. Universities feel that vulnerability keenly because the harmful impacts of several essentially unrelated policy lines seem to be converging on those institutions. If those lines truly do meet, then there is the real prospect of very serious damage to universities and to the intellectual activity they sustain. Let me briefly describe those lines and explain why they should be of interest to Members whose responsibilities include the maintenance of America's capacity for science and science education.

One set of policies impinging on universities is that generated by deficit reduction pressures. With the exception of the research budget of the National Science Foundation, virtually every federal program on which universities rely is slated for significant reductions. The proposed cuts in student aid, in the NIH budget, and in Medicare and Medicaid reimbursement will strike heavy blows at mainline university activities, and will force either reductions in institutional programs or the increased subsidizing of those activities by other elements of the institution.

Second, the proposed revisions to OMB Circular A-21, just published, which would cap particular components of indirect cost recovery, will hit the budgets of research universities heavily. If those rules take effect as proposed, losses in the millions of dollars a year will be incurred by some institutions, and virtually all universities will suffer noticeable reductions.

Although the new rules may be prompted, in part, by the deficit pressures, the impetus for them predates the present crisis and really derives from a mistaken view of some that the costs of research that can be associated with an individual project are somehow more real and important than are those costs that need to be pooled and allocated to all projects. That may sound to you, as it does to me, like a rather arcane bit of accounting theology, but unfortunately the effect of policies based upon it will be to starve the body while expecting the brain to continue to function. Such a policy will not work for long.

The third line of policy converging on universities makes the effects of the first two even more devastating. The tax reform bill that passed the House last year contains a number of provisions that will simultaneously cost universities more money and severely undermine their ability to raise money from private philanthropy. The deliberations that led to the passage of the House bill did not include considerations of education or science policy, but the effect of the provisions adopted must be taken into account by anyone who cares about the health of America's universities or the nation's capacities in science and technology.

Let me make it clear that none of the university presidents I know claims a special educational exemption from the solution of the nation's fiscal problems, nor do they ascribe these problems to some dark, anti-university conspiracy. However, all would, I think, argue that the combination of circumstances I have described exposes universities to special and largely unintended jeopardy, and they would wish that important fact to be considered by those who make policy for the nation.

But the question you have a right to ask is, What is to be done? The answers for this year are clear enough, and you will surely be hearing them repeated in the coming months. They are to support budget levels that will help sustain the enterprise through a difficult period; to help to prevent arbitrary, damaging, and nonnegotiated changes in the principles that govern indirect cost recovery by urging OMB to withdraw the proposed revision and enter into genuine consultation with affected parties; and to oppose changes in the tax code that would lessen the incentives for private philanthropy and thereby make it less likely that private efforts can compensate for the inevitable diminution in federal programs.

That is the immediate program, and it is an important one. But it is not enough. If we are to achieve solutions to our current problems that will not just provide short-term relief but will also lay the foundation for sustained economic health, then I submit that it is necessary to begin to think of national budgeting in more than arithmetic terms. We do not put together budgets in private or public life solely in order to have them balance at the end. What happens at the end is the result of a complex set of judgments about what we need and what we can afford. In all organizations except government, we distinguish between expenditures for current use and investments aimed at future return. Without that elementary distinction it is impossible to make analytical sense out of our national accounts or to know whether we are spending too much or too little. And if we are unable to do that, it is hardly any wonder that we are unable to come to grips with the question of how much money we need to raise as a nation in order to meet the demands of the present and the challenge of the future.

In that last sentence lies the key element in your efforts to find a broad and solid base for the future productivity of basic scientific and engineering research and training and therefore for the health of the institutions in which those take place. In my personal view, there is no coherent and realistic program for meeting the nation's real needs that does not take a hard look at revenues along with expenditures. When all is said and done, we are not paying for what we need, and any solution that does not confront that fact will do more harm than good.

I am aware, Mr. Chairman, that these opening remarks go far afield from the testimony that one would ordinarily give on this occasion. I have done so because it seems to me evident that when you have finished work on this DOD budget, you will, as Members of Congress, face an agenda that is even more important to science and to universities than the annual budget of any single agency can be. I urge you to bring to those larger issues, the same purposes and perspectives that move you to believe that the university research programs of the Department of Defense merit your support. More than at most times, this year's motto must be, "One war, many fronts."

**Report of the White House Science Council Panel on the Health of Universities and Colleges**

Before turning to our specific comments and suggestions with regard to the FY 1987 Authorization for the Department, I must call to your attention an important new report by the White House Science Council titled A Renewed Partnership. The analyses, conclusions and recommendations of this report bear directly upon the university research programs and the FY 1987 budget proposals of the Department of Defense.

In 1984 Dr. George A. Keyworth, Science Advisor to the President, asked a panel of the White House Science Council, chaired by Mr. David Packard and Dr. D. Allan Bromley, to examine the health of universities and to determine whether they are equipped to meet our future requirements for highly trained talent and new knowledge. The Council shortly will publish the results of their eighteen month study. The Panel's report is a thorough examination of the health of our universities and of their capabilities to meet our future requirements for well trained talent and new knowledge. We commend to your particular attention several of the Council's conclusions and recommendations. The prepublication Executive Summary is attached (ATTACHMENT).

The Council's report reaffirms a fundamental fact: our universities and colleges are important to our national interest because they produce the scientific and technical talent essential to our economic productivity, our technological progress, our health, our national security, and ability to compete in the international marketplace. While our universities remain unequaled in the world, there are troubling signs that their capabilities to attract and educate the best students in science and technology are being steadily eroded. Problems associated with obsolete equipment, outdated laboratories, increasingly severe shortages of advanced students and faculty are not being properly addressed. They continue to hamper us in essential fields of science and engineering.

We will all do well to consider thoughtfully the implications of the Council's sobering conclusion:

"Our universities today simply cannot respond to society's expectations for them or discharge their national responsibilities in research and education without substantially increased support."

We are, it seems, at a crossroads. We see it clearly, for example, in the indicators of our position in the international marketplace. Every one of our balance of trade indicators now has turned negative. Since 1980 even our high technology balance of trade has steadily declined. Our agricultural trade balance now is also negative. Industrial productivity continues to erode steadily, especially in comparison to our foreign competition. Our greatest need is for talent. Highly trained people are our richest resource. Yet, we face a shortage of highly trained talent. At current production rates, and in the face of a declining student pool, we face serious shortfalls of trained scientists and engineers. Erich Bloch, Director of the National Science Foundation, two weeks ago reported to a special meeting of the National Academy of Sciences that continuation of present policies and practices may well yield a drop from 1983 of nearly 700,000 bachelor-level scientists and engineers by the year 2011. We are failing to attract sufficient numbers of U.S. citizens, especially minorities and women, into advanced training in science and engineering. The result is a growing dependency upon foreign nationals, an uncertain source of supply. The recent NSF report Science Indicators 1985 states that between 1980 and 1983 total full-time enrollment in graduate engineering and science programs grew by 6 percent; however, 85 percent of this increase is accounted for by foreign students. And, despite the increase in total enrollment, foreign graduate student populations in the top 25 percent of graduate departments actually declined significantly.

In 1983 foreign students accounted for about 40 percent of total graduate enrollment in engineering, mathematics and computer sciences. More than one-half of PhD degrees earned in engineering now are awarded to foreign nationals. Fortunately, about 40 percent of the engineers and 60 percent of computer scientists remain here. Still, undergraduate enrollments in engineering, computer science and related fields are climbing to record highs. As they do, we are increasingly dependent upon foreign nationals to teach them. We simply are failing to attract sufficient numbers of talented U.S. students into high quality graduate programs in engineering and science.

Many of our universities lack sufficient numbers of faculty to sustain growing undergraduate programs at the highest level of quality. The Engineering Education Task Force (formed by the National Society of Professional Engineers, the American Society for Engineering Education and the National Association of State Universities and Land-Grant Colleges) reports the following:

- Engineering faculty shortages remain a paramount concern. Currently, one in twelve budgeted positions is vacant. As much as a 23 percent increase in positions is needed to bring the student-faculty ratio close to optimum teaching conditions.
- High enrollments at the undergraduate level strain an already sparse faculty and poor conditions for instruction.

while enrollments have grown more than 115 percent over the past fifteen years, faculties have growth by only 10 percent.

- A majority of entering engineering students is in the top 10 percent of their high school graduating class; their ability is helping, but only somewhat, to offset present limitations.

The root cause of this situation is obvious to all who have examined the situation carefully: we are underinvesting in academic research and advanced education. In 1984, the nation invested nearly $100 billion in research and development; only $8.4 billion was invested in universities. Despite overall gains of about 8 percent in FY 1984, and larger increases in essential fields such as computer science and mathematics, overall Federal investment in universities and colleges continues to decline as a percentage of total Federal R&D. Nevertheless, Federal agencies are, and will remain, the primary source of national investment in basic science and engineering.

In FY 1986, according to the National Science Foundation, Federal agencies will provide two-thirds of total academic R&D support. Academic institutions are expected to spend $7.1 billion in FY 1986 for the portion of the total that is basic research; two-thirds ($4.8 billion) will come from Federal agencies.

At present rates, our total investment in R&D will double in ten years. This, the White House Panel concludes, will be inadequate to our needs. Present policies and funding programs will not do the job required. More rapid growth is essential if our universities are to meet future requirements and maintain our critical technological advantage.

Recently, Dr. Alan Bromley, CoChairman of the White House Panel, in a briefing for a special meeting at the National Academy of Sciences, reported that, if present levels of Federal investment are sustained for a decade we will fall "an order of magnitude short" of meeting our needs in the 1990s. The research agencies of the Federal government, the Science Council concludes, are the only source of funding for the needed investments.

Each of the following recommendations of the White House Science Council Panel has immediate implications for the FY 1987 Authorization of the Department of Defense. The Council recommends that Federal government agencies that support university research take the following steps:

- increase substantially investments in universities and colleges,
- establish university-based interdisciplinary, problem oriented research and technology centers,
- bear the full share of the cost of university research,
- establish policies that recognize university infrastructure (research facilities and equipment) costs as integral to university research,
- minimize burdens and expand the flexibility of the administrative arrangements for the support of research,
- establish substantial programs of multiyear, merit-based graduate fellowships in science, mathematics and engineering, and
- encourage interdisciplinary activities at the graduate level.

The White House Science Council, in summary, invites all of us to consider two alternative investment policies for our research and training enterprise. One is to continue present policies of incremental and decremental adjustments to a system already seriously hampered by the effects of prolonged underinvestment. A second alternative, endorsed by the Council, is to make the difficult decisions now, even in these unusually difficult budgetary circumstances, to double federal investments in university research and training programs, including those of the Department of Defense and thereby to seize the rich and unprecedented opportunities for scientific and technological progress.

## RECOMMENDATIONS

Mr. Chairman, we endorse the recommendations of the Science Council, and we urge the Subcommittee to incorporate them in the FY 1987 DOD Authorization. We offer the following recommendations:

### Reverse the Erosion of the 6.1 Research and Technology Base Programs

Despite recent absolute, but restrained, gains, DOD 6.1 research and 6.2 Advanced Technology Development programs hold a steadily eroding position within the total RDT&E program. In FY 1981 the 6.1 and 6.2 Technology Base programs accounted for about 16 percent of total RDT&E funding. By FY 1985 they had declined sharply to just 10.1 percent of total RDT&E. The decline continues. In FY 1987 Technology Base programs account for 8.5 percent of the total budget. In just six years the 6.1 share of the total program declined by more than one-third, from 3.7 percent of the total RDT&E budget to 2.3 percent. In constant dollar terms the 6.1 programs remain significantly below their FY 1965 levels. Clearly the rapid buildup of DOD investment in R&D is failing to reach the foundation of the RDT&E enterprise; i.e., fundamental research and training in basic science and engineering.

**We recommend that the balance between 6.1 Research and 6.2 programs and total RDT&E effort be restored to approximately FY 1981 levels; i.e., the level of relative effort that existed just prior to the recent buildup of RDT&E activity.**

**We also ask the Committee to assist the Department in further strengthening its university activities by providing a clear legislative mandate to expand and sustain its 6.1 and 6.2 programs at levels consistent with the recommendations of the White House Science Council.**

### Sustain and Strengthen the University Research Initiative

Mr. Chairman, last year this Subcommittee led the effort to establish the University Research Initiative (URI). Guided by your recommendation, the House approved an initial authorization of $200 million for it. The Congress appropriated $100 million for the program, including, wisely, $75 million in the Office of the Secretary. After losing funds as the result of Congressionally-mandated untargeted reductions and the Gramm-Rudman-Hollings sequester, about $90 million will be available this year for URI activities. The URI is a significant accomplishment and an excellent starting point. Provided they are carefully developed in a manner consistent with the intent of the Congress, the URI programs will respond to several of the major recommendations of the Congress, the White House Science Council and the university community.

We regret, therefore, that the FY 1987 request for the URI fails to sustain the program at the appropriated FY 1986 level. Only $49.5 million is requested; this is less than half the appropriated amount. The funds are divided equally among the four participating Services. No funds are requested for the Office of the Secretary. This funding level and implied organization of the program, we believe, are inadequate responses to the strong commitment made by the Congress to the URI last year. We believe that the experience of the first year clearly demonstrates the need for carefully articulated and consistent URI objectives in each of the Services and for strong and effective coordination of all URI planning and activities.

**We ask the Subcommittee to sustain your commitment to the URI this year by again authorizing the program at a level of $200 million. Further, we strongly urge the Committee to provide a continuing role for the Office of the Secretary in the development and coordination of the URI program objectives, policies and activities. Vesting budget and program authority for URI development in OSD will ensure the continued development of balanced, integrated and effective focus for the URI and more cost-effective management of its programs.**

## Address Research Facilities and Equipment Needs

The research capital deficit continues to be the most pressing problem facing universities. For more than twenty years no Federal research agency has reinvested broadly in the modernization of university laboratories engaged in its competitive research programs. In the absence of a significant federal participation, according to the National Science Foundation, universities continue to fall further behind in their efforts to meet capital needs. In FY 1984 universities spent more than $1.2 billion for facilities and equipment for research, development and instruction; however, approximately 90 percent of these funds came from nonfederal sources. After taking the effects of inflation into account, the real level of capital investment by our universities has declined 20 percent in ten years. In FY 1974 the Federal agencies provided 27 percent of the total facilities funds spent by universities; in FY 1984 the Federal share was only 12 percent, and essentially all of these funds were dedicated to specialized facilities.

Because federal agencies have recognized the serious consequences posed by obsolete research equipment, important progress is being made on the equipment problem. In FY 1984 universities spent $518 million for research equipment, an increase, according to NSF, of 15 percent in constant dollars over 1983 levels. Federal research agencies supplied about two-thirds of these funds. After many years of neglect, Federal investment research equipment again is growing at a reasonable rate. The challenge remaining before us is clearly stated by the report of the White House Science Council. We must match our commitment to research equipment with an equal investment in the modernization of the laboratories themselves.

A recent DOD report affirms this conclusion. Last April, at the request of the Subcommittee, the Department submitted to this Committee a report titled Selected University Laboratory Needs In Support of National Security. That report examined the facilities needs of a relatively small number of key universities in just five fields: chemistry, electronics, engineering, materials, and physics. The report identifies almost $700 million of immediate needs for laboratory modernization in these five fields; it is not a comprehensive examination of the needs of even the relatively few institutions surveyed.

The report recommends that DOD undertake a $300 million, five-year facilities program targeted on the highest (Priority One) DOD research needs. The report emphasizes that all funds should be allocated competitively as increments to competitive research awards. For the reasons elaborated in my oral statement, we cannot emphasize too strongly the importance to the long-term health of the Department's research programs of resisting any further attempts to earmark funds for particular institutions, either for research facilities or for research project support. Scientific and technical merit must remain the dominant criteria for the award of scarce federal resources.

Eleven higher education associations, science and engineering societies have adopted statements that reaffirm the importance of merit-based allocation of federal research and research facilities funds. For your information, these statements are attached (ATTACHMENT).

The Department's April 1985 report recommends extension of the University Research Instrumentation Program (URIP). We ask the Committee to sustain the URIP program as a part of the developing URI.

The DOD report concludes by calling upon other federal agencies to assist in addressing the laboratory needs that impact on the national science and technology base. This recommendation is generally consistent with the report of the White House Science Council. The Council assigns high priority to the research facilities needs of universities, and it recommends that a special ten-year catchup effort be undertaken by the National Science Foundation, the agency with which DOD shares lead responsibility in supporting fundamental research in engineering, computer and physical sciences. (To illustrate, in FY 1987, according to the National Science Foundation, DOD will be the primary source of support for the conduct of basic engineering research in universities and colleges. The Department will account for 39 percent of total federal investment in engineering research; NSF will provide 37 percent of the total.)

**We ask the Committee to (1) adopt the facilities recommendation of the DOD report by establishing a university research facilities modernization program as a separate line-item authority within the Office of the Secretary, and (2) fund it in the first year at least at the level of the University Research Instrumentation Program ($30 million per year).**

Expanded direct investment in research facilities and equipment must be accompanied by further improvements in the utilization of available funds and instruments. Further opportunities to improve the acquisition and management of equipment by agencies, universities and others need to be pursued. Last summer the AAU, the National Association of State Universities and Land-Grant Colleges and the Council on Government Relations published a report titled _Financing and Managing University Research Equipment_. It suggests several steps that might usefully be taken by funding agencies, state governments, industry and universities to strengthen the acquisition of equipment and improve the utilization of costly research instruments. The Executive Summary of the report also is attached (ATTACHMENT).

### Request a Fresh Assessment by the Defense Science Board (DSB) of DOD-University Programs and Relations

Finally, in the light of the developments discussed above, we believe that the time for a fresh comprehensive assessment of the Department's university research programs and its relations with universities has come. In 1981 this Subcommittee asked the Department to prepare a report on the responsiveness of universities to national security needs. In January 1982 the Defense Science Board published its report. That report greatly influenced the subsequent development of DOD policies and programs for universities.

Five years have elapsed since the DSB conducted its last inquiry.

Much is changed; several new initiatives are underway. A year from now it may be helpful, therefore, to have the results of a new examination by the DSB of DOD university policies and programs.

Among the questions that a report by the DSB next year might usefully address are the following:

- What has been been the effect on 6.1 research programs of the recent buildup of RDT&E activities? Is there an appropriate balance between investment in fundamental research, the research capabilities of universities and our future defense needs?
- How will implementation of the recommendations of the Packard Commission on DOD procurement affect the Technology Base programs and participation in them by universities?
- Are the Services giving sufficient emphasis to fundamental research as the buildup of hardware and development programs proceeds?
- Does the Department have sufficient resources and personnel to properly develop and manage expanding university research, training and infrastructure programs?
- Is the University Research Initiative being implemented in a manner consistent with (1) the intent of the Congress and (2) the needs of universities that engage in technology base research?
- Is implementation of the Competition in Contracting Act having consequences for the Department's university research programs? There has been enough experience to warrant a careful look at whether implementation of the Act is imposing unintended results on university research programs.

**Conclusion**

Thank you, Mr. Chairman, for this opportunity to present these views and suggestions to the Subcommittee. We remain ready to work with you. I will be pleased to respond to your questions.

DRAFT January 13, 1986

# A RENEWED PARTNERSHIP

An examination of federal government-university-industry interactions in U.S. research and higher education in science and engineering.

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## White House Science Council Panel on the Health of U.S. Universities and Colleges

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Deputy Director
Office of Science and Technology Policy

## II. EXECUTIVE SUMMARY

On May 3, 1984, Dr. George A. Keyworth, Science Advisor to the President, asked the White House Science Council to examine how well our colleges and universities are prepared to produce the scientific and technical talent required for pre-eminence in an age of rapid technological change and intense international competition. He asked the Council to examine the basic health of our universities, as well as their relationship to industry and government, and to recommend measures to ensure that the most basic of America's advantages remains just that--an advantage in an increasingly competitive world.

In reply, the Council established the Panel on the Health of U.S. Colleges and Universities with representatives from the research community, both academic and nonacademic. This report is the result of their eighteen-month study.

### OVERVIEW

Our university system remains unmatched in the world; we cannot, however, take its continued superiority for granted. To assess the system's future, the Panel asked the following questions:

- Are our universities attracting the best students into science and engineering?
- Is the education received by today's students preparing them for the challenges of the 21st century?
- How well can our universities respond to changing demands?

The answers cause us concern, because they reveal the consequences of obsolete equipment, aging facilities, and growing shortages of students and faculty in important fields.

We are certainly not alone in recognizing that science and technology are critical to our future. Nations everywhere are investing in these capabilities. We conclude that we must rethink and, in many ways, rebuild the critically important interactions between universities, government, and industry that have served this nation so well in the past. The federal government-university relationship is too fundamental to the maintenance of our national science and technology base to be taken for granted, and the industry-university partnership is emerging as critical to exploiting that base in order to compete in the world marketplace.

One conclusion is clear: our universities today simply cannot respond to society's expectations for them or discharge their national responsibilities in research and education without substantially increased support. In 1984, only $8 billion of the nearly $100 billion in total national research and development was performed in universities, a level that simply does not reflect our dependence on the availability of the most able technical talent. An economy whose growth prospects depend upon maintaining a competitive edge in technology must look to an increasing--not decreasing--emphasis on the source of this technical talent.

The strength of the nation in trade, defense, and health has been directly related to past investments in science and technology. Our future position in global markets will similarly depend on our willingness to respond to opportunity and to mobilize our strengths today. To this end, we must promote a broad interdisciplinary approach to problem-solving by focusing on university-based centers that will improve cooperative linkages between scientists, engineers, and industry.

In the summary which follows, we present the Panel's major findings and recommendations. We believe that they demand the attention of the nation, and that if they are implemented, our universities will respond enthusiastically and effectively. Our present leadership in international science and technology is challenged; indeed, many consider it fragile and endangered. We are confident that the actions we recommend will allow us to retain this leadership. We cannot afford less.

FINDINGS

- A healthy university system is the basis for our future. In any ranking of priorities for allocating R&D support--both federal and private--universities must rank first.
- Demands for new talent and new knowledge have never been greater. Universities will not be able to respond to these growing needs without increased federal support. In particular, we encourage continuation of present administration policies to further increase basic research as a fraction of total national R&D funding.
- Of equal importance with the level of funding is the stabilization of federal support to permit more effective use of financial and human resources. The most ambitious research requires long lead times for preparation and incubation. Research groups are exceedingly fragile; once disbanded, they can rarely be reassembled. In the absence of stability and predictability, important opportunities have been lost, scarce resources have been used inefficiently and, most serious, some of the brightest young minds in each recent generation have been lost to science and technology.
- The universities themselves must share the responsibility for the deterioration of their health and capability. In attempting to ride out what were hoped to be temporary budget shortfalls, they mortgaged their research futures too often using limited funds to maintain research personnel rather than investing in needed instrumentation or facilities. Moreover, research faculty members have themselves too often forgone high risk exploratory

research which, were it to succeed, could have impressive payoff.

- State and local governments as well as private philanthropy, play a vital role. Their initial investments develop the structures and programs that make universities competitive for federal investment, and they provide resources by which academic institutions preserve their autonomy and diversity. Moreover, such support is a major element of the shared responsibility that typifies the present university-Federal Government partnership.
- The diversity of our college and university system is an essential element of its strength.
- In recognition of the leadership demands that our society will place upon them, it is essential that mechanisms be developed for early identification and support of our most able youth.
- Strong university-government-industry partnerships are fundamental to meeting our goals in economic competitiveness, national security, agriculture, health, and in improving the quality of life of our citizens.

## RECOMMENDATIONS

A. To maintain the strong science base essential to our national future, we recommend that:

1. The Federal Government make substantially greater investments in our centers of learning in the 1980's and 1990's than in the 1970's. The recommendations set forth in this report, if they are to be implemented fully, require significant increases in financial support. The source of such funding in these times of fiscal stringency is not obvious. Reallocation of R&D appropriations appears to be the most probable source, but we believe that incremental new funding will be required. In any case, we emphasize that this federal investment, at minimum, must keep pace with

the overall national investment in R&D; at the current rate of growth it will double in ten years. More rapid growth is essential if our universities are to meet the burgeoning demands being made upon them from almost every sector of our society. The Federal Government is the only practical source of funding for the major part of this growth.

2. The federal government support a major initiative to establish university based interdisciplinary, problem-oriented research and technology centers directed to problems of broad national needs and relevant to industrial technology.
3. The federal government bear its full share of the cost of the university research it supports.

B. To build a solid partnership among the federal government, industry, and universities; to enable the university infrastructures to keep pace with research and educational needs; and to assure that the universities are able to pursue research and education effectively, we recommend that:

1. Federal policies recognize that university infrastructure (research facilities and equipment) costs are integral and, therefore, necessary parts of federally sponsored, university-based research costs.
2. The portion of federal research grants and contracts that reimburse universities for use or depreciation of facilities and equipment (use allowances) be based on realistic useful lifetimes:
    a. Useful life of buildings and facilties should be reduced from the present level of 50 years to 20 years.
    b. Useful life of equipment and instrumentation should be reduced from the present level of 15 years to 5 to 10 years, depending on the class of equipment.

These changes, which do no more than inject reality into the costs of doing research, will increase substantially the indirect fraction of total costs. This increase should not be drawn from direct research costs but from reallocation of funds from other sources.

3. To allow U.S. universities to restore their infrastructures in a timely fashion, a facilities fund be established within NSF for each of the next ten years. And that in order to encourage excellence:
    a. All proposals submitted to this facilities fund should be subjected to peer review within the scientific or technological community involved, and
    b. All awards from the fund should be made on a 50/50 matching basis with non-federal funding.
4. Any reorganization of the federal tax code recognize the importance of increased industry-university interaction. A 25% nonincremental tax credit should be established for industrial funding of university research and for industry-supported maintenance and servicing of university equipment. A tax deduction equal to the full market value of all industrially contributed equipment should be established.

C. To minimize controversy and friction concerning the reimbursement of indirect costs, we recommend that:

1. Reimbursements for administrative costs within the indirect cost category be fixed at a uniform percentage of modified total direct costs. That percentage should be determined by calculating the mean national percentage over a five-year historical period and should be phased in over a two-year period to allow those universities now charging more than the new

fixed rate to plan for reduction. This change will eliminate any need for faculty effort reporting.

2. The formal requirement for cost-sharing be eliminated.
3. The paperwork burden associated with grant and contract administration, as perhaps best exemplified by the above mentioned requirement for faculty effort reporting--but much more pervasive--be reduced to a minimum.
4. All federal agencies supporting university research adopt the NSF practice of including the indirect costs in the project budget subject to peer review.

D. In order that the university environment be conducive to high-quality research and education; that it be attractive to the best minds; and to increase the effectiveness with which federal funding is used for research, we recommend that:

1. Federal agencies work toward an average grant or contract duration of at least three, and preferably five years.
2. Investigators be free to use up to 10% of their grant or contract support on a fully discretionary basis and be permitted to carry unexpended funds forward from one fiscal year to the next.
3. Federal agencies make greater use of block grants or contracts to support groups of investigators having shared research interests.
4. For greater flexibility, to facilitate changes in an investigator's field of research, and to support high-risk research, federal agencies, except in the cases of young investigators, place substantially more emphasis upon the research history of the investigator and less on the proposed research project in making awards.

E. To identify and educate our most talented youth more effectively, and to enable experienced scientists and engineers to continue to contribute their skills in a changing technological environment, we recommend that:

1. A substantial program of merit-based, portable scholarships be established by the federal government at the undergraduate level. Parallel programs should be established by industries having significant dependence upon university research and education. The national goal should be for the most able 1% of the undergraduate students in mathematics, engineering, and the natural sciences entering colleges or universities each year to be supported under these programs.
2. Substantial programs of multiyear merit-based fellowships, both federal and industrial, be established in science, mathematics, and engineering at the graduate level. Reflecting national needs, the field distribution of these fellowships would be expected to change over time.
3. Universities encourage interdisciplinary activities at the graduate level while retaining the essential quality control function now played by the traditional disciplinary departments.
4. Industries and universities develop attractive continuing education programs for engineers and scientists that are matched to contemporary industrial requirements and to modern science and technology.

# STATEMENTS ON MERIT REVIEW BY HIGHER EDUCATION ASSOCIATIONS AND SCIENCE AND ENGINEERING SOCIETIES

AAU
*Association of American Universities*

## AAU STATEMENT ON DECISION MAKING IN FEDERAL FUNDING FOR RESEARCH FACILITIES

The Association of American Universities represents institutions whose faculties are deeply engaged in research. We share with many other institutions and individuals a commitment to advancing the quality of the nation's research effort. Since the vitality of this effort is closely linked to the soundness of decisions made about science by public bodies, it is both appropriate and important for the AAU to state its collective views about the ways in which those decisions are best made.

The United States has evolved an admirable but fragile system of awarding federal funds for research. In general, Congress appropriates funds for the support of broad categories of research. Subsequently, the administering federal agency issues guidelines for making applications in a manner that assures fair and open competition. Researchers then submit detailed proposals that are judged by experts, scientists chosen for their ability to make sound and careful judgments in the scientific area involved. This method maximizes the scientific return on the federal investment by assuring that awards are made on the scientific merit of the proposal and the professional merit of the proposer.

The same method governed most federal programs in support of scientific facilities when such programs existed. However, in the early 1970s, most federal government programs in support of the construction and renovation of research facilities ended. The subsequent decade-long failure to attend to the capital base of university science has led to a backlog of need that has hampered American science and placed great stress on the processes by which the government allocates scientific resources.

We believe that processes based on the informed peer judgments of other scientists need to be preserved and strengthened. We therefore urge scientists, leaders of America's universities, and Members of Congress to support the practice of awarding funds for the support of science on the basis of scientific merit, judged in an objective and informed manner. Further, we urge them to refrain from actions that would make scientific decisions a test of political influence rather than a judgment on the quality of the work to be done. These principles should apply in making decisions about scientific facilities as well as in awarding funds for research projects.

Finally, we urge officials of the national Administration and Members of Congress to deal promptly with the decay of the physical plant that houses much of the nation's basic research. S.1537, introduced by Senators Danforth and Eagleton, is a bipartisan effort to deal with this national priority and deserves strong and prompt support.

October 25, 1983

*Suite 730 ● One Dupont Circle ● Washington, DC 20036 ● (202) 466-5030*

National Association
of State Universities
and Land-Grant Colleges

Robert L. Clodius, President

## STATEMENT ON FEDERAL FUNDING OF ACADEMIC FACILITIES

In recent years, federal funding of various higher education programs had decreased markedly. In particular, wholly inadequate resources for facilities has led some institutions to seek direct assistance from Congress. The outcome of such a process could be an irrational system of distribution based solely on political influence. In that regard, the National Association of State Universities and Land-Grant Colleges shares the concerns of the Association of American Universities, the National Academy of Sciences, and others, that this approach is unacceptable, in that it could diminish the capability of higher education to carry out its mission in education and research, and we urge Members of Congress and leaders of colleges and universities to refrain from this practice.

We further urge the Congress to fund Title VII of the Higher Education Act and similar programs in other agencies at reasonable levels, and to insure the systematic allocation of resources to satisfy pressing national concerns.

November 13, 1983

The Council of Graduate Schools in the United States
One Dupont Circle, N.W. Suite 430 Washington, D.C. 20036-1173 Phone: 202/223-3791

## RESOLUTION NO. 1

## RESOLUTION IN DECISION MAKING IN THE FEDERAL FUNDING FOR RESEARCH FACILITIES

WHEREAS the United States has evolved an admirable but fragile system of awarding federal funds for research, and,

WHEREAS this system is dependent upon fair and open competition responding to federal agency guidelines, and peer review judgment by experts in the scientific area to be studied, and,

WHEREAS this method of peer review has governed most federal programs in support of scientific facilities when and where such program exist, and,

WHEREAS most federal programs to support construction and renovation of research facilities have been ended through a shifting of federal priorities, and,

WHEREAS in the absence of such programs colleges and universities are suffering a gradual increasing erosion in their ability to support state-of-the-art research in all scientific fields, and,

WHEREAS CGS member institutions share with many other institutions and individuals a commitment to advancing the quality of the nation's research effort. The vitality of this effort is closely linked to the soundness of decisions made about scientific research by public bodies.

NOW THEREFORE BE IT RESOLVED that the Council of Graduate Schools supports the recently adopted AAU Statement on Decision Making in federal funding for research facilities. CGS urges the national Administration and members of Congress to support the practice of awarding funds for research or facilities on the basis of scientific merit judged in an objective manner. CGS would further urge support for new spending authorities to support research facilities to keep our nation's investment in academic research facilities from becoming out of date.

Passed at the CGS 23rd Annual Meeting 12/83

Affiliates:
Conference of Southern Graduate Schools
Midwestern Association of Graduate Schools
Northeastern Association of Graduate Schools
Western Association of Graduate Schools

AMERICAN COUNCIL ON EDUCATION
Office of the President

# MEMORANDUM

**TO:** ACE Board of Directors

**FROM:** J. W. Peltason

**SUBJECT:** Proposed Statement on Federal Funding of Research and Instructional Facilities

**DATE:** January 9, 1984

Community concern has been generated by the recent attempts of several institutions to bypass the customary review process to obtain federal funding for research facilities. The Association of American Universities last fall issued a statement urging scientists, leaders of America's universities, and members of Congress "to support the practice of awarding funds...on the basis of scientific merit...(and) to refrain from actions that would make scientific decisions a test of political influence rather than a judgment on the quality of the work to be done."

Similar statements have been issued subsequently by the National Academy of Sciences, the National Association of State Universities and Land-Grant Colleges, and the American Association of State Colleges and Universities. The ACE Commission on Governmental Relations discussed this matter at its fall meeting, and recommended that the Board adopt the following statement:

"There is a pressing need for increased federal support for the rehabilitation of research and institutional facilities. Established procedures for these support programs involve a system of review to assure equitable consideration and the awarding of funds on the basis of merit.

"At a time when fiscal constraints have severely restricted many federal programs, it is especially important to sustain the process which assures systematic allocation of scarce resources. Therefore we call upon leaders of the academic community and members of Congress to reaffirm the principle of broadly representative review of project proposals in fair and open competition, so that funding decisions continue to represent the best interests of both higher education and the national welfare."

One Dupont Circle Washington D.C. 20036-1193
President (202) 833-4710 Vice President (202) 833-4712

## NSB Statement on Bypassing Merit Review in the Funding of Academic Research Facilities

Recent efforts by educational institutions to secure funding by appealing directly to Congress and bypassing the merit based review system represent the wrong solution to a real and urgent problem. The problem of deteriorating university research facilities threatens the health of the Nation's science and engineering base. To generate better solutions, the parties involved should meet to plan new initiatives that support university research without threatening the established science and engineering priority setting process that has served so well to promote excellence.

In the past two years, fifteen universities have bypassed that process and secured over $100 million for construction of facilities by appealing directly to Congress. In a number of cases, the funds were diverted from other scientific activities that had been selected on the basis of their merit.

The National Science Board has examined the implications of this development for the excellence and productivity of U.S. science and engineering, which today is the strongest in the world. As the challenge to America's competitiveness in defense and industry grows, so too does the Nation's reliance on its science and engineering strength. Bypassing the normal standards of scientific excellence through merit review procedures in science and engineering research jeopardizes this strength.

The problem is not yet severe, but the precedent has been established; lobbyists sense a source of funds, and each new circumvention increases pressure on schools that have so far resisted the temptation to pursue the same course. The question facing American universities today is this: Will they retain responsibility for the excellence of U.S. science and engineering, or will they cede it to purely political processes. The choice is in the hands of the science and engineering community. The trend is in the wrong direction.

The circumventions of merit review are being triggered by a serious problem: At many universities, facilities are deteriorating. Until this problem is addressed, the erosion of merit review will continue. A concerted effort -- by universities themselves as well as state and Federal Government -- to attack the facilities problem must be launched. For this, universities will indeed have to exert their political influence. But that influence must be directed at a long-term solution, not at the short-term and ultimately self-defeating steps of the past two years.

Too much is at stake to continue on the present course. As university facilities deteriorate, U.S. science and engineering will lose its grip on world leadership. If universities respond to deteriorating facilities by circumventing merit review, the decline in U.S. leadership will accelerate, and excellence will deteriorate into mediocrity.

To address these issues and to launch actions to solve them, the National Science Board:

a) Will continue to press the scientific community for strict self-regulation. It urges all professional societies, associations, academies, industry researchers, faculty and principal investigators to act in concert and support the peer review system.

b) Will evaluate the comprehensive merit review process, as part of a continuing process of scrutiny and improvement and as a reflection of the need to reassert the importance of the merit review system. Based on the evaluation, changes and improvements will be made, if required.

c) Calls for a Conference on Academic Research Facilities among the interested parties, to be sponsored by the NSB, the National Academies, and the Office of Science and Technology Policy. The conference should be held as soon as possible, utilizing talent from the financial community, Congress, state goverments, federal agencies, academic institutions and business to define the problem and propose solutions.

NATIONAL ACADEMY OF SCIENCES
2101 Constitution Avenue Washington, D.C. 20418

## STATEMENT OF THE COUNCIL

## FEDERAL FUNDING FOR RESEARCH FACILITIES AND INSTRUMENTATION

In recent months, there have been a few instances in which federal funding decisions for major university scientific facilities have not been subject to an appropriate review process. Informed peer judgments on the scientific merits of specific proposals, in open competition, should be a central element in the awarding of all federal funds for science.

In the past, such objective systems of evaluation have met the needs of our country well, and have contributed to the scientific preeminence of the United States. In the long term, they also help to maintain the pluralism that is important to the productivity of American science and is characteristic of political decision making.

We urge that the academic community and public officials exercise vigilance to protect this informed evaluation and decision-making process in the awarding of funds, not only for the support of scientific research proposals, but also for major scientific facilities and instrumentation.

October 30, 1983

## FEDERATION OF AMERICAN SOCIETIES FOR EXPERIMENTAL BIOLOGY

### PEER REVIEW

"WHEREAS the peer review system has served in an exemplary fashion to promote the progress of biological science in this country, and

"WHEREAS federal support for research facilities through political decision-making rather than through peer review can be extremely disruptive of the orderly scientific process, be it

"RESOLVED that public officials move promptly to make federal money available in a more systematic way, through peer review mechanisms, to upgrade the biomedical research facilities of this country, and be it further

"RESOLVED that research scientists, research institutions, and public officials recognize the central need for open peer-reviewed competition for federal funds for research and research facilities, and refrain from circumventing the peer review process to achieve their goals."

May 23, 1984

American Association of State Colleges and Universities One Dupont Circle/Suite 700/Washington, D.C. 20036 (202) 293-7070

**NAME OF COMMITTEE:** Committee on Science and Technology
**CHAIR OF COMMITTEE:** John Wright
**NAME OF PRESENTER:** John Wright
**DATE:** **November 22, 1983** RESOLUTION #13

WHEREAS, The 358 member institutions of the American Association of State Colleges and Universities (AASCU) are committed to fostering scientific research beneficial to our nation,

WHEREAS, Federal funds for research projects and facilities are traditionally awarded on the basis of their scientific merit judged in a fair and open competition,

WHEREAS, An equitable process of peer review at Federal agencies must be the guiding force in the awarding of funds for new scientific facilities and research projects,

WHEREAS, Recent efforts by some institutions have bypassed this preferred peer review process,

WHEREAS, Other scientific and educational associations have urged the reversal of these recent actions and an adherence to peer review procedures in all future scientific funding, be it

RESOLVED, That the American Association of State Colleges and Universities (AASCU) join with these other groups in reaffirming the principle that funds for the support of science be awarded on the basis of "scientific merit, judged in an objective and informed manner" by a panel of peers, and be it further

Resolution #13
Page 2

**RESOLVED,** That we urge scientists, educators and members of Congress to "refrain from actions that would make scientific decisions a test of political influence rather than a judgment of the quality of the work to be done." *

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* AAU Statement on Decision Making in Federal Funding for Research Facilities, October 25, 1983.

Council of Scientific Society Presidents

Public Policy Statement

August 1, 1985

## SCIENTIFIC REVIEW OF FEDERAL SCIENCE PROJECTS

### Recommendation

The Council of Scientific Society Presidents adopts the following recommendation of the National Science Board:

> The National Science Board "calls for a Conference on Academic Research Facilities among the interested parties, to be sponsored by the NSB, the National Academies, and the Office of Science and Technology Policy. The conference should be held as soon as possible, utilizing talent from the financial community, Congress, state governments, federal agencies, academic institutions and business to define the problem and propose solutions."

The Council also approves the principle that all scientific projects, whether for a specific research program or for the development or construction of a facility, should be evaluated by a merit review process by impartial experts before being funded by agencies of the Federal Government.

### Discussion

Several instances have recently been reported in which educational institutions have attempted to secure funding for scientific facilities by appealing directly to Congress, thereby bypassing the customary merit-review process by independent scientists. Fifteen examples of this are given in Table II in the appendices to the report of the National Science Board Committee on Excellence in Science and Engineering. Our committee has noted that all these examples involve the construction or development of scientific facilities, not scientific research projects per se. No instances have been cited where proposals for scientific research programs, as contrasted with proposals for the development or construction of facilities, have bypassed the well-established peer review process..

Proposals for federal support for the construction or development of scientific facilities should be subjected to the traditional independent merit review in the same way that scientific research projects are reviewed. The peer review process has been very successful in the post-World War II period of U.S. scientific eminence. The country's scientists have devoted a great deal of time not only to the analysis and review of scientific proposals but also to service on countless technical advisory panels in various branches of the government. If these scientists lose confidence in the willingness of the government to take proper account of scientific advice, it may become more difficult to secure appropriate advice in the future.

At the same time, it should be recognized that the evaluation of proposals for the construction of scientific facilities requires consideration of additional factors than is the case with proposals for the support of specific research projects. The peer review process should certainly be a regular part of the total review process to evaluate the general competence and achievement of the scientific staff that will operate the facility and to review the science that is planned for the facility. But there are other questions here, such as the distribution of scientific facilities in various parts of the country, the issue of which areas of science are in greatest need of additional facilities, and the desirability of support for emerging centers of excellence. (Recall, for example, the creation and development of the University of California at La Jolla in recent times.) For some of these questions, internal agency reviews might be the appropriate process, a procedure that has been used to some extent with proposals for facilities in agricultural research. However, whatever additional considerations are taken into account, a peer review by independent scientists should be a basic component in the deliberations.

In the report of the National Science Board Committee on Excellence in Science and Engineering, whose charge was very similar to that of our committee, Section C is entitled "Characterizing and Attacking the Facilities Problem." Following their brief analysis of this question, the NSB Committee proposes, in Recommendation 3 on page 5 of the report, that a conference be held to "define the problem and propose politically feasible solutions."

Conclusion

The Council of Scientific Society Presidents adopts the following recommendation of the National Science Board:

> The National Science Board "calls for a Conference on Academic Research Facilities among the interested parties, to be sponsored by the NSB, the National Academies, and the Office of Science and Technology Policy. The conference should be held as soon as possible, utilizing talent from the financial community, Congress, state governments, federal agencies, academic institutions and business to define the problem and propose solutions."

The Council also approves the principle that all scientific projects, whether for a specific research program or for the development or construction of a facility, should be evaluated by a merit review process by impartial experts before being funded by agencies of the Federal Government.

1c

**The American Physical Society**

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## STATEMENT OF THE APS COUNCIL

## SCIENTIFIC REVIEW OF RESEARCH FACILITIES FUNDING

We deplore the inclusion in the federal budget of major scientific projects that have not been subjected to the normal process of proposal submission and expert review. The consequences go beyond the diversion of scarce resources from projects of higher priority. Institutions are increasingly persuaded that political maneuvering is more important than scientific justification in securing federal funds. Yet each year many worthy scientific projects must be abandoned or deferred for lack of funds. The developing pattern of funding major projects without subjecting them to impartial expert scrutiny diminishes science.

Quite clearly Congress is responsible for considering a variety of factors--such as geographic balance, economic need, and affirmative action--in allocating funds for major projects of any sort. We urge, however, that review by impartial scientific experts be an important consideration in any allocation of funds for research facilities.

January 20, 1985

American
Association
for the Advancement of
Science

1333 H STREET, NW, WASHINGTON, D.C. 20005 [illegible]
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## Statement on the Federal Funding of Science

By the Board of Directors
American Association for the Advancement of Science
December 10, 1983

In the long-standing relationship between government and science in the United States, major responsibility for funding basic scientific research has settled upon the government partner. For its part, the scientific community has accepted primary responsibility for defining research needs and opportunities and providing assurance that public funds are allocated on a priority basis, through peer evaluation. For either partner to breach its responsibility carries serious risk to the solidarity of what has proved an extraordinarily effective partnership.

The Board of Directors of the American Association for the Advancement of Science is concerned that failures to adhere both in principle and in practice to criteria of scientific choice at all times will serve only to diminish public confidence in the peer review system as the basis for allocating national resources, with serious negative consequences for the integrity and advancement of science.

American
Association
for the Advancement of
Science

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## Resolution on
## Scientific Peer Review

Whereas the partnership between the government and the community of scientists is essential to the advancement of science, and

Whereas, without broadly based, consistent, critical, and professional evaluation of proposed expenditures for scientific work, there is a growing danger that the quality of research and education in science will be jeopardized,

Be it resolved that the Council of the AAAS reaffirm its commitment to the principle and practice of scientific peer review as indispensable to the allocation of public funds for the scientific enterprise.

Adopted by the AAAS Council,
May 30, 1985

# FINANCING AND MANAGING UNIVERSITY RESEARCH EQUIPMENT

Association of American Universities

National Association of State Universities
and Land-Grant Colleges

Council on Governmental Relations

Washington, D.C. 1985

## SUMMARY AND RECOMMENDATIONS

Contemporary science and technology are inconceivable without the array of instruments and other research equipment available today. Recent years, however, have seen steady erosion of our universities' ability to acquire and maintain equipment that qualifies as state of the art--the best generally available. Without this new equipment, advances in many scientific disciplines cannot occur. The situation has reached the point where it threatens the strength of the nation's research enterprise and the quality of education of new scientists and engineers.

The project summarized here was designed to seek ways to ensure that the funds available for scientific equipment in universities are used at maximum efficiency. We examined federal and state regulations and practices, management practices in universities, and sources and mechanisms of funding. We reached the following broad conclusions:

**Many actions can be taken that clearly would enhance efficiency in the acquisition, management, and use of research equipment by universities, and they are specified in our recommendations. The overall problem is so large, however, that it cannot be properly addressed without substantial, sustained investment by all sources--federal and state governments, universities, and the private sector.**

## SOURCE OF THE PROBLEM

The situation has been documented in a succession of studies dating from the early 1970s. The most recent and most comprehensive study is the National Science Foundation's National Survey of Academic Research Instruments, covering the years 1982-1983. Newly published results of the survey show in part that:

- Of the university department heads surveyed, 72 percent reported that lack of equipment was preventing critical experiments.
- Universities' inventories of scientific equipment showed that 20 percent was obsolete and no longer used in research.
- Of all instrument systems in use in research, 22 percent were more than 10 years old.
- Only 52 percent of instruments in use were reported to be in excellent working condition.
- Of university department heads surveyed, 49 percent rated the quality of instrument-support services (machine shop, electronics shop, etc.) as insufficient or nonexistent.

### Contributory Trends

Such difficulties stem from several interrelated trends. As scientific instruments have grown steadily more powerful and productive, their initial costs have significantly outpaced the general rate of inflation. One industrial laboratory, for example, found that the cost of keeping its stock of research equipment at the state of the art rose 16.4 percent per year during 1975-1981, while the consumer price index rose 9.9 percent per year. The growing capabilities of equipment also entail higher costs for operation and maintenance. The rapid pace of development, moreover, has shortened the technologically useful life of equipment; instruments today may be superseded by more advanced models in five years or less. And for more than 15 years, the funds available from all sources have failed consistently to reflect the rising costs and declining useful lifetimes of academic research equipment.

Research project grants, the leading source of academic research equipment, have only slightly outpaced inflation in recent years. Individual grants averaged about $94,000 at the National Science Foundation (NSF) in 1985 and $133,000 at the National Institutes of Health (NIH). Such grants can accommodate instruments of only modest cost. Benchtop equipment priced at $50,000 or more is common, however, and research in a number of fields is relying increasingly on equipment that costs from $100,000 to $1 million.

Trends in funding of scientific equipment in universities have long been dominated by federal spending, which accounted for 54 percent of the equipment in use in 1982-1983; the universities themselves are the next most important source of support and provided 32 percent of such funding. States directly funded 5 percent of the cost of the equipment in use in 1982-1983, individuals and nonprofit organizations funded 5 percent, and industry funded 4 percent. Federal funding of academic research--including the associated equipment--grew at an average annual rate of 15.7 percent, in constant dollars, during 1953-1967, but the rate fell to 1.6 percent during 1968-1983.

Besides its role in support of research, the government was a major contributor to the universities' massive capital expansion of the 1950s and 1960s, which included substantial amounts of scientific equipment. Again, however, the rate of federal investment turned downward. The government's annual spending on academic R&D facilities and equipment, in constant dollars, fell some 78 percent during 1966-1983.

## RESPONSES TO THE PROBLEM

Both academic and federal officials responded to essentially level funding by supporting people over investment in capital equipment. The fraction of research-project support allocated to permanent university equipment by the National Institutes of Health declined from 11.7 percent in 1966 to an estimated 3.1 percent in 1985. At the National Science Foundation the fraction fell from 11.2 percent in 1966 to an average of 7.1 percent during 1969-1976. The federal mission agencies' support for research equipment declined similarly, although exact data are not available.

Efforts to ease the universities' serious difficulties with scientific equipment began to appear in the early 1980s. NSF increased its investment in academic equipment from 11 percent of its university R&D budget in 1978 to an estimated 17.5 percent in 1985. The Department of Defense launched a special five-year university instrumentation program, totaling $150 million, which is projected to run through 1987. The Department of Energy began a special $30 million program scheduled to end in 1988. The federal and state governments adopted tax incentives designed to encourage contributions of equipment by its manufacturers. State governments began to increase their funding of equipment for state colleges and universities and have initiated a range of development activities designed in part to attract industrial support for R&D in their universities.

The expanded federal investments were the result, in part, of the efforts of the Interagency Working Group on University Research Instrumentation, which was organized in mid-1981 to focus high-level agency attention on the university instrumentation problem. Its members were senior officials drawn from each of the six major agencies supporting research in universities--the National Science Foundation, the National Institutes of Health, the National Aeronautics and Space Administration, and the Departments of Agriculture, Defense, and Energy.

## BACKGROUND OF THE STUDY

Although these initiatives are welcome, they clearly are not sufficient. Officials in academe and government agree that the equipment problem is critical and steadily growing and that ways to use existing resources more efficiently must be explored. In July 1982 at the request of the Interagency Working Group, the Association of American Universities, the National Association of State Universities and Land-Grant Colleges, and the Council on Governmental Relations convened an ad hoc planning committee to consider whether a special effort was needed to address the following questions:

o Could changes be made in federal or state laws, regulations, or policies that would enhance the efficiency of acquisition, management, and use of academic research equipment?

o What more can universities do to improve the way they acquire, manage, and use research equipment?

o Does debt financing hold significant untapped potential for universities as a means of acquiring new research equipment?

o Can present tax incentives for the donation of research equipment to universities be revised to increase support from industry?

o Are there alternative methods of direct federal funding of research equipment that would yield a better return on the federal investment?

The resulting analysis was carried out jointly by the three associations with funding from the six federal agencies and the Research Corporation. Substantive direction for the study was provided by a seven-member Steering Committee chaired by Richard Zdanis, Vice Provost of Johns Hopkins University. Much of the field research was done by a three-member team: Robert Bock, Dean of the Graduate School at the University of Wisconsin; David Litster, Director of the Center for Materials Science and Engineering at MIT; and Julie Norris, Assistant Provost of the University of Houston. This team visited 23 universities and governmental and industrial laboratories; they met with more than 500 faculty investigators, department chairman, research and service center directors, deans and chief administrators, or the functional equivalents in government and industry. (A list of the places visited is appended to this summary.) The team and the firm of Coopers & Lybrand each produced background reports for the project.

## RECOMMENDATIONS

The actions recommended below, as we stated at the outset, would clearly enhance efficiency in the acquisition, management, and use of academic research equipment. We would like to emphasize, however, that even if all these recommendations are acted upon, the universities' equipment needs are so large that they cannot be met without substantial increases in funding. Modernization, moreover, cannot be a one-time effort. Continuing investment will be required based on the recognition that laboratories in many fields of science have to be reequipped at intervals of five years or less. The universities, the states, and industry must share with the federal government the responsibility for modernization and long-term maintenance of the quality of scientific equipment at the nation's universities.

The recommendations that follow appear in the topical order employed in the full report: the federal government, the states, the universities, debt financing by universities, and private support for equipment.

### The Federal Government

The federal government has been the major funder of research equipment in universities during the past four decades. Current federal funding mechanisms, however, do not comprise adequate means of regularly replacing obsolete or worn-out equipment with state-of-the-art equipment. Regulatory and procedural difficulties complicate the problem.

We recommend...

1. **That the heads of federal agencies supporting university research issue policy statements aimed at removing barriers to the efficient acquisition, management, and use of academic research equipment.** Few federal regulations, as written, contribute directly to the equipment problem. Inconsistent interpretation of regulations by federal officials, however, complicates the purchase, management, and replacement of research equipment and leads to unnecessarily conservative management practices at universities. Desirable actions are summarized in the recommendations below.

2. **That federal agencies more adequately recognize and provide for the full costs of equipment, including operation and maintenance, space renovation, service contracts, and technical support by...**

...providing these costs in project grants and contracts or ensuring that recipients have provided them.

...accepting universities' payment of costs such as installation, operation, and maintenance as matching funds on programs that require matching contributions by universities.

3. **That federal agencies adopt procedures that facilitate spreading the cost of more expensive equipment charged directly to research-project awards over several award-years and allow the cost and use of equipment to be shared across award and agency lines.** Individual research-project grants and contracts normally can accommodate equipment of only modest cost. Investigators, moreover, have difficulty combining funds from awards from the same or different agencies to buy equipment.

4. **That federal auditors permit universities to recover the full cost of nonfederally funded equipment from federal awards when they convert from use allowance to depreciation.** Office of Management and Budget (OMB) Circular A-21 permits such conversion as well as recovery of full cost. Auditors of the Department of Health and Human Services, however, permit recovery only as if

the equipment were being depreciated during the time it was in fact covered by the use allowance. This practice, in effect, denies recovery of full cost.

5. **That the Office of Management and Budget make interest on equipment funds borrowed externally by universities unequivocally an allowable cost by removing from OMB Circular A-21 the requirement that agencies must approve such charges.** Interest on externally borrowed funds has been a permissible cost since 1982 at the discretion of the funding agency, but agencies have shown significant reluctance to permit it. The perception of inability to recover interest costs may lead university officials to decide against seeking debt financing for equipment.

6. **That all federal agencies vest title to research equipment in universities uniformly upon acquisition, whether under grants or contracts.** Federal regulations on title to equipment vary among agencies, and such variability inhibits efficient acquisition, management, and use of equipment. Without assurance of title, for example, investigators hesitate to combine university funds with federal funds to acquire an instrument not affordable by a single sponsor.

7. **That the Office of Management and Budget make federal regulations and practices governing management of equipment less cumbersome by...**

...setting at $10,000 the minimum level at which universities must screen their inventories before buying new equipment and, above that minimum, permitting universities and agencies to negotiate different screening levels for different circumstances.

...raising the capitalization level for research equipment to $1,000 in OMB Circulars A-21 (now at $500) and A-110 (now at $300) and giving universities the option of capitalizing at different levels.

8. **That the Department of Defense eliminate its requirement that the inventory of the Defense Industrial Plant Equipment Center (DIPEC) be screened for the availability of specialized**

scientific equipment requested by universities before new equipment is purchased. The descriptions of equipment in the DIPEC inventory do not permit a federal property officer to determine whether a scientific instrument in the inventory is an adequate substitute for the one requested. Hence, the requirement for screening is wasteful for both universities and the government.

9. **That other federal agencies adopt the NIH and NSF prior approval systems.** Purchases of equipment with federal funds ordinarily must be approved in advance by the sponsoring agency. Purchases can be approved by the university, however, under the NIH Institutional Prior Approval System and the NSF Organizational Prior Approval System. These systems markedly improve speed and flexibility in acquiring equipment.

## The States

State governments act as both funder and regulator in regard to academic research equipment, and conflict between these roles is inherent to a degree in the relationship between the states and their public universities. Still, we believe that in many cases the states could combine these broad roles more rationally and could otherwise help to ease the schools' difficulties with research equipment.

We recommend...

1. **That states assess the adequacy of their direct support for scientific equipment in their public and private universities and colleges relative to support from other sources and the stature of their schools in the sciences and engineering.** The states cannot displace the federal government as the major funder of academic research equipment, but judicious increases on a highly selective basis could be extremely beneficial to the scientific stature of states while simultaneously increasing the effectiveness of funds available from federal and industrial sources.

2. That states grant their public universities and colleges greater flexibility in handling funds. Desirable provisions would permit schools to transfer funds among budget categories, for example, and to carry funds forward from one fiscal period to the next. Greater flexibility would not only improve the universities' ability to deal with the problems of research equipment, it would also be likely to provide direct savings in purchasing and would free academic administrators to discharge their responsibilities more efficiently.

3. That states examine the use of their taxing powers to foster academic research and modernization of research equipment. Tax benefits available under the federal Internal Revenue Code are also available in 34 states whose tax codes automatically follow the federal code. Relatively few states, however, have adopted tax benefits designed to fit their particular circumstances.

4. That states revise their controls on procurement to recognize the unusual nature of scientific equipment and its importance to the research capability of universities. Scientific equipment often is highly specialized. Instruments that have the same general specifications but are made by different vendors, for example, may have significantly different capabilities. The differences, furthermore, may be discernible only by experts in the use of the equipment. Desirable revisions in state controls would exempt research equipment from purchasing requirements designed for generic equipment and supplies, such as batteries and cleaning materials; would vest purchasing authority for research equipment in individual colleges and universities; and would not apply rules beyond those already mandated by the federal government.

5. That states consider revising their controls on debt financing of scientific equipment at public colleges and universities to permit debt financing of equipment not part of construction projects, recognize the relatively short useful life

of scientific instruments, and relieve the one- and two-year limits on the duration of leases.

## The Universities

The universities' ability to acquire and manage research equipment efficiently is affected by their individual circumstances, their traditionally decentralized authority, the individual project-award system that funds much of the equipment, and state and federal regulations. Within this context, however, we have identified a number of management practices that warrant more widespread use.

Our findings indicate that universities would benefit from stronger efforts to improve their internal communications. Moreover, our recommendations on the whole imply a need for a more centralized approach than is now the general practice in universities' management of research equipment. We note that other developments, including the universities' growing interest in debt financing and strategic planning, also point toward more centralized management.

We recommend...

1. **That universities more systematically plan their allocation of resources to favor research and equipment in areas that offer the best opportunities to achieve distinction.** Such strategic planning should involve participation by both administrators and faculty. The process may well call for hard decisions, but we believe that they must be made to optimize the use of available funds.

2. **That universities budget realistically for the costs of operating and maintaining research equipment.** These costs impose serious and pervasive problems, and failure to plan adequately for full costs when buying equipment is widespread as well. Full costs include not only operation and maintenance, but space renovation, service contracts, technical support, and the like.

Maintenance is particularly troublesome. Hourly user charges are commonly assessed to cover the salaries of support personnel and the costs of maintenance, but are difficult to set optimally and are rarely adequate.

**3. That investigators and administrators at universities seek agency approval to spread the cost of expensive equipment charged directly to research-project awards over several award-years.** As noted in Recommendation 3 under the Federal Government, individual research grants and contracts cannot normally accommodate costly equipment, and this problem would be eased by spreading costs over several years.

**4. That universities act to minimize delays and other problems resulting from procurement procedures associated with the acquisition of research equipment.** To be most effective, the procurement process should be adapted to the specialized nature of research equipment, as opposed to more generic products. Similarly, specialized purchasing entities or individuals would facilitate timely acquisition of equipment at optimum cost. Also beneficial would be formal programs designed to inform purchasing personnel and investigators of the needs and problems of each.

**5. That universities establish inventory systems that facilitate sharing.** One such system is the basis of the research equipment assistance program (REAP) at Iowa State University. The REAP inventory includes only research equipment. REAP may not be cost effective for all universities, but most should find elements of it useful.

**6. That universities use depreciation rather than a use allowance to generate funds for replacing equipment,** providing that they can negotiate realistic depreciation schedules and dedicate the funds recovered to equipment. Universities can use either method, but rates of depreciation are potentially higher--and so recover costs more rapidly--than the use allowance (6 2/3 percent per year) because they can be based on the useful life of the equipment. Both methods, however, add to indirect costs, and neither can be used for equipment purchases with federal funds.

7. **That universities seek better ways to facilitate the transfer of research equipment from investigators or laboratories that no longer need it to those that could use it.** Faculty at most schools have no incentive to transfer equipment, excepting the need for space, and every incentive to keep it in case it might be needed again. Some systematic mechanism for keeping faculty well informed of needs and availability of equipment would be useful.

## Debt Financing of Research Equipment

Universities traditionally have used taxexempt debt financing to pay for major facilities and lately have been using the method to some extent to buy research equipment. A number of financing methods can be adapted to the special characteristics of such equipment, but whatever the method, such financing competes with other university needs for debt. Debt financing imposes risk on the university as a whole, and so implies a shift from decentralized toward centralized authority.

We recommend...

1. **That universities explore greater use of debt financing as a means of acquiring research equipment, but with careful regard or the long-term consequences.** Universities vary widely in their use of debt financing, but a universal concern is the need for a reliable stream of income to make the debt payments. It should also be recognized that the necessary commitment of institutional resources, regardless of the purpose of the debt financing, erodes the university's control of its future, in part by reducing the flexibility to pursue promising new opportunities as they arise. Debt financing also increases the overall cost of research equipment to both universities and sponsors of research.

2. **That universities that have not done so develop expertise on leasing and debt financing of equipment.** This expertise should include the ability to determine and communicate the true costs of debt financing and should be readily accessible to

research administrators and principal investigators. The increasing complexity of tax-exempt debt financing, the many participants, the necessary legal opinions, and the various political and/or corporate entities associated with debt financing make it essential that universities fully understand the marketplace.

## Private Support

The effects of the Economic Recovery Tax Act (ERTA) of 1981 on corporate spending on R&D and corporate contributions of research equipment to universities are not clear, for several reasons: the act has been in effect only since August 1981, its effects are entangled with other economic variables in a complex manner, and the uncertain future of the R&D tax credit, which is scheduled to expire at the end of 1985, may have skewed corporate response to it (the equipment donation provision is permanent). Nevertheless, the consensus appears to be that ERTA, suitably modified, should indeed spur technology, in part by fostering support for academic research and scientific equipment. We agree with this view.

We recommend...

1. **That industry take greater advantage of the tax benefits provided by the Economic Recovery Tax Act (ERTA) of 1981 for companies that donate research equipment to universities and fund academic research.** Universities' experiences with industry indicate that company officials may not be fully aware of the benefits available, although company tax specialists generally are well informed.

2. **That universities seek donations of research equipment more aggressively by developing strategies that rely in part on the tax benefits available to donors.** Sound strategies would stress both federal and state tax benefits as well as other important benefits to both donor and recipient.

3. **That Congress modify ERTA so that...**

...equipment qualified for the charitable donation deduction include computer software, equipment maintenance contracts and spare parts, equipment in which the cost of parts not made by the donor exceeds 50 percent of the donor's costs in the equipment, and used equipment that is less than three years old. Computers are properly viewed as computing systems, which are incomplete without software. Maintenance of scientific equipment is costly to the point where universities have declined donations of equipment because they could not afford to maintain it. Makers of sophisticated equipment rely primarily on their technological knowledge, not their ability to make parts. Thus the limit on parts from outside suppliers is unrealistic, provided that the manufacturer is in fact in the business of developing and making scientific equipment.

...the provisions on the R&D tax credit are made permanent, with revision to create an additional incentive for companies to support basic research in universities. Equipment acquired under research contracts qualifies for the credit, but ERTA currently provides the same incentive for companies to contract for research in academe as for research by other qualified organizations.

...the social and behavioral sciences are made qualified fields of academic research in terms of the equipment donation deduction and the R&D tax credit. The social and behavioral sciences contribute to the application and utilization of science and technology, and they rely increasingly on research instrumentation.

...qualified recipients of equipment donations and R&D funding, in terms of ERTA tax credits, include research foundations that are affiliated with universities but remain separate entities. Some state universities have established such foundations to receive and dispose of donated equipment because they cannot dispose of it themselves without legislative consent.

These actions, we are convinced, would yield material benefits in the acquisition and management of research equipment by universities. The rationale for them here is necessarily brief. Much fuller background will be found in the five chapters of the full report, where these recommendations also appear.

Mr. PRICE. Do you know if any of the universities lobby?

Mr. ROSENZWEIG. Unfortunately, I do, and I deplore that practice. I am not—my point is not that Congressmen are uniquely guilty or sinners at all. I don't believe they are.

Mr. PRICE. Have you ever discussed this with university presidents and so forth and asked them not to follow such a policy?

Mr. ROSENZWEIG. I have done that, we have done that. It is a difficult proposition, in part because the needs are real. They are not imaginary.

Mr. PRICE. I just wonder how much of that goes on.

Mr. ROSENZWEIG. A fair amount. Yes, there are a lot of attempts at persuasion and in reasoning together. Sometimes it works, more often than not it works. Sometimes it doesn't.

Mr. PRICE. It is not all bad, either. We need institutions with the facilities to do these jobs, and we want to keep them in business, too.

Mr. ROSENZWEIG. Indeed. We want to make sure also that the money goes where it will do the most good for the people of the Nation.

Mr. PRICE. Does staff have any questions?

Mr. BATTISTA. I was just wondering, along that line, Mr. Chairman, Dr. Rosenzweig, is it facetious to think perhaps you can get agreement within the university community that this isn't going to be accepted in the future, that basically these individual actions are undermining the entire program, and it would wreck the entire initiative? Can you come up with basically a standard of conduct in this area so that people can compete and that the merit system is restored? Is that just too far out?

Mr. ROSENZWEIG. I think the situation we have is that there is already very substantial agreement to that proposition, I would say to the point of 98 percent, say. There are those who, for good and sufficient reasons of their own, prefer to behave differently or feel the need to behave differently, and there really isn't any way to discipline them, and there isn't any proper form of discipline.

What is happening is that a continuation of efforts by that 2 percent, say, which find a response in the Congress puts additional pressure on those who would prefer not to behave in that way, those who are committed to the system, but whose faculties, boards of trustees, come to them and say, "Well, where are we? There is this university down the road, they just got $9 million, our case is at least as good as theirs. Where is our $9 million?"

And the President says, "Well, it is bad for the system to do business that way," and he can do that for a few years. If he is courageous, maybe he can do it for more than a few years, but eventually the point will come when even the most well-meaning of them will say, the system has changed, and if we are to survive in this world, we have to change with it. And then the walls will come tumbling down. I don't think we are at that point now, but I think we are approaching it.

Mr. BATTISTA. You could always bring to bear indirect pressure. For example, if you can get the cooperation, fine, you can say you got your brick and mortar money, I am not going to give you any more grants, so you have this empty building. I think it is to the detriment of the whole community. Certainly you can bring the power of the purse string to bear on a problem like this. I think you are going to have to protect the 98 percent and prevent the system from completely deteriorating or degenerating, and I am just wondering if there is anything the administration could do to help.

Obviously, the Congress is going to help to the extent that it doesn't affect the guy in his district. You know, we are against this so long as it is in his district, not this fellow's. Can you convince those in the White House and several of the other folks who can bring the requisite amount of pressure to convince those folks this isn't the proper action to take?

Mr. ROSENZWEIG. I think moral persuasion is probably the most that can be mounted. I think all of us would say that we don't want to use the grantmaking system, whose results ought to be based on the merits of individual proposals, as a way of punishing institutions who have behaved badly in some other respect. That would be to do to ourselves what others are trying to do to us, and I don't think that would be a good idea.

Mr. BATTISTA. The prevailing attitude seems to be, "Do unto others and cut out".

Mr. ROSENZWEIG. That is right. My suggestion would be the one I started out by making, and that is that some of the pressure could be taken off of the system by providing funds for what is a legitimate and very important and extremely pressing need, and that is the modernization and renovation and construction of research facilities. If this committee can see its way clear to putting money in the Defense Department, in the Office of the Secretary, for that purpose, I think it would then give those Members of Congress, who don't like this any better than I do or you do, a way of saying to their constituents, "Well, your needs are real, they are legitimate, take them over to this program in the Office of the Secretary and compete for them, and if you win, God bless you, and if you don't, try harder next time."

Mr. PRICE. Thank you very much. Your full statement will be included in the record.

Mr. ROSENZWEIG. Thank you very much, Mr. Chairman.

Mr. PRICE. Thank you very much.

[Whereupon, at 11:30 a.m., the subcommittee was adjourned subject to the call of the Chair.]

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